

newscientist



Why US lamps last longer

Brave new words.



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David Meiklejohn, a young engineer who has spent the past two years researching planned obsolescence in the lighting industry, argues that the lives of lamps in Britain both could and should be greater. Comparable lamps in the United States have lives which are two or three times longer—presumably because of the competition that exists there, (see p 519).

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Comment

Official secrets

The number of cups of tea drunk each year in the Ministry of Agriculture is a piece of official information. A civil servant communicating such information to a member of the public could himself be prosecuted and so could the recipient. Such are the sweeping powers of Section 2 of the Official Secrets Act. Most journalists, including the staff of *New Scientist*, acquire all manner of official information—a great deal of it trivial and much that is of only passing relevance—while researching stories of interest for their readers.

Last November, the Home Secretary, Merlyn Rees, told the House of Commons that "the receipt of information should no longer be an offence". Indeed, reform of the 1911 Act generally, and repeal of the thoroughly discredited Section 2 in particular, has been promised by successive governments since its review by the Franks Committee in the aftermath of the abortive prosecution of Jonathan Aitken and the *Sunday Telegraph* in 1971.

Thus, by recharging *New Scientist* freelance contributor Duncan Campbell and former army corporal John Berry with Section 1 of the Official Secrets Act (the part used in serious espionage cases like the Vassall affair) while leaving the defendants still out on bail, the Attorney-General, Sir Silkin, last week devalued what little public respect was left for this iniquitous piece of legislation. Surely, if there is any substance to these very serious charges (and we will not know until 9 August when committal proceedings are expected to commence), then these supposedly dangerous individuals carrying information "prejudicial to the safety or interests of the state", should be locked up and not allowed the chance to make day trips to Calais? One may conclude that last week's additional charges, which up the maximum penalty from two years to 14 years, are bankrupt and merely a big stick wielded to frighten the defendants into pleading guilty (under Section 2). Time will tell.

The principle at stake here is not whether Duncan Campbell is guilty of receiving official information—most of us are guilty of that—but the clumsy and disquieting use of the Official Secrets Act by the authorities to stifle investigative journalism in sensitive technical areas. What the nation unquestionably needs is a clearly defined law to protect us from the unprincipled, misguided or mischievous. What a healthy democracy does not need are sweeping laws that allow bureaucratic inefficiency and official incompetence to go unchallenged. The Government could make a major and lasting contribution to the quality of life in Britain by hurrying forward the proposed Official Information Act, which would invert our present secrecy legislation and substitute laws which make all official information freely available unless specifically denied. Swedes and Americans already enjoy such an open society. In Britain we do not.

Nicholas Valéry

An evil trade

This week the Royal College of Physicians, joined for the first time by surgeons, obstetricians, family doctors, psychiatrists, paediatricians, and the Faculty of Community Medicine, has issued its third report on smoking and health (see page 516). But this time, 15 years after the college fired its original broadside against the noxious weed, the title has been changed to "Smoking or Health". The doctors, unlike the Government, are unwilling to pussyfoot.

The perils of smoking have been paraded before us so forcefully and so consistently over the past decade that

many people now react to anti-smoking propaganda in the same way that a majority respond to the daily news of bloody and brutal strife in Northern Ireland. The direct warnings and strongest exhortations of militant anti-tobacco groups, like ASH, are not allowed to penetrate the conscious mind. Nobody wants to know that "smoking deaths are now at least four times more numerous than deaths from road accidents". The committed smoker is able to ignore the ugly fact that each time he (or, increasingly, she) lights up another fag about five-and-a-half-minutes are lopped off his lifespan. Addicts come to their senses when it is too late—when a mother or father of a growing family dies, or when that gripping pain in the chest is felt, or when the habitual phlegm becomes stained with blood.

All this being so, it is the Government's clear duty to encourage and to impose something far more drastic than the "paultry and hesitating" measures so far taken to reduce the fatal grip on the community of this highly profitable and grossly immoral trade in death. It is inexcusable and incomprehensible that the tobacco companies should still be allowed to plaster the hoardings with propaganda suggesting that cigarettes are accepted accessories of the good life. It is shameful and scandalous that the public purse should receive vast sums of money from the dealers in and users of this evil stuff. A high proportion of cigarette smokers would, apparently, like to kick the habit. Why can't the Government find the courage needed to give them a helping hand?

Donald Gould

Environment day

The United Nations Environment Programme established by the Stockholm conference in 1972 is five years old this week—an anniversary which is celebrated by World Environment Day on 5 June.

It is always easy to knock the UN specialised agencies as being wasteful, ineffectual, political talkshops. But they have their defences, too. The most obvious feather in UNEP's cap is the emerging set of protocols under the Mediterranean convention of 1976. All but two of the riparian Mediterranean states are now locked into a series of meetings on common procedures for pollution monitoring, controls over land-source and ship-source pollution, and the environmental impact of future industrial and urban development. UNEP has facilitated this anti-pollution feast. It is now up to the governments to benefit by it.

A second, but as yet less advertised, feather is the International Referral Service. There are now over 3000 governmental and non-governmental information sources, cross-indexed in great detail on a computer file in Geneva—but duplicated in a growing number of national focal points (including one as yet unstaffed point in our own DOE). These and other anti-pollution information projects go far towards satisfying the industrial world of UNEP's relevance.

The failure must be that the agency has yet to become deeply involved in the development process. The British government is almost alone in considering development to lie outside UNEP's brief. The Jamaican delegate to the governing council expressed a more general view when he stated that poverty breeds pollution, and that the vital issues for most of the world are the evils of malnutrition and starvation, and the provision of shelter for the poor. Until UNEP assists with the planning of sustainable and environmentally benign economies—on a national basis—it will be only one-half of what the Stockholm conference wanted it to become.

Richard Sandbrook

Thisweek

Gene jugglers prepare foundations for insulin factory

Under what appears to have been an unusual degree of secrecy, William Rutter, Howard Goodman (see photograph), and their colleagues at the University of California, San Francisco, have succeeded in inserting copies of rat insulin genes into the bacterium *Escherichia coli*. The research team is particularly interested in analysing the structure of the gene to learn how it normally makes insulin. The successful insertion is of course an important first step in the much publicised notion of constructing a bacterial "insulin factory".

Commenting on the experiment, Stanford biologist Paul Berg said "it has fulfilled a prediction that many people have been confident about for two years". Berg told *New Scientist* that there are a number of tricky problems to be solved before the gene can be made to operate properly in its new environment. Although he is certain that these problems will be overcome, he guesses that it will take longer than the six months that Rutter is reported to have claimed.

The classic genetic engineering technique is to isolate the gene you are interested in, insert it into a small circular piece of DNA known as a plasmid, and then insert the combined plasmid and gene into a bacterium where it will be treated as normal genetic material. There are of course many technical problems, the first of which is isolating the



gene. The Californian team chose the backdoor route for this step: instead of chopping the gene out of the rat chromosome, they isolated the message (mRNA) that the gene normally makes, and then made a DNA copy of that. This DNA copy of the message (known as cDNA) is in effect a copy of the original gene. It was this that Rutter stitched into a plasmid (pMB9) which was then inserted into a strain of *E. coli* (X1776) specially developed for genetic engineering. Rutter and his colleagues describe details of their experiments in a paper recently

accepted by *Science*; the paper, which is anxiously awaited by DNA researchers, is not yet scheduled for publication.

The insulin gene codes for a protein known as preproinsulin which has four separate regions: two of these regions are snipped off before true insulin emerges. This complexity poses a problem for genetic engineers intent on creating an insulin factory: assuming the eventual success of the ingenious devices currently being worked out for encouraging animal genes to operate normally in bacterial cells, the preproinsulin molecule so produced would have to be processed into insulin before it is medically useful.

Yet another issue to be settled before commercial exploitation is a viable prospect is the stability of the animal gene in the bacterial environment: a number of researchers have recently noticed that under these conditions the DNA sequence of inserted genes is sometimes altered. If this happens routinely then the gene would rapidly lose its ability to code for its specific protein, thus smashing the dreams of genetic engineers. Berg told *New Scientist* that "It would be very worrying if animal genes turn out to be incompatible with *E. coli*".

The Californian team's experiment will stand as a landmark in genetic engineering research. It remains to be seen how much the many problems will impede the erection of future landmarks. □

Government responds to Flowers report

Nine months after the Royal Commission on Environmental Pollution, under its then-chairman Sir Brian Flowers, issued its 240-page report *Nuclear Power and the Environment* (*New Scientist*, vol 71, p 676), the government has come up with its answer—a 20-page White Paper from the Secretary of State for the Environment. The government will set up several new committees, including a Nuclear Waste Management Advisory Committee and a committee to advise the energy and environment ministers on the interaction between energy policy and the environment. The most substantial change to spring from the RCEP report is the shift from the Department of Energy to the Department of the Environment of responsibility for nuclear waste management in Britain.

The Department of the Environment will take over the waste research work undertaken by the UK Atomic Energy Authority. The government is reviewing both the existing arrangements for the control of radioactive waste and the adequacy of the present research effort. The findings of these reviews will be published in another White Paper.

The RCEP report discussed general energy policy and its views "will be taken into account in a Green Paper which the Government intends to publish later this year," Environment Secretary Peter Shore told the House of

Commons last Friday.

One of the Royal Commission's principal recommendations was that: "There should be no commitment to a large programme of nuclear fission power until it has been demonstrated beyond reasonable doubt that a method exists to en-



"Now we'll need a committee to halt the proliferation of committees"

sure the safe containment of long-lived, highly radioactive waste for the indefinite future." The White Paper says: "The Commission's proposition is bound to be the dominant factor in any further preceding decisions about further large-scale programmes (including any programme of fast reactors)". Shore told a press conference last Friday that there would be some sort of public debate—perhaps a planning inquiry commission—held before the government takes a final decision on the proposed Commercial Fast Reactor (CFR).

■ Australia's inquiry into one aspect of nuclear power—uranium mining—came to an end last week with the publication of the second report of the Ranger Uranium Inquiry. The report says that if the Australian government decides to allow the country's uranium resources to be exploited, there should be a gradual build up of mining. The Ranger project should be allowed to proceed, but, with the possible exception of the Pancontinental proposal, there should be no other mining in the region for the time being.

The report says that before mining is allowed there should be comprehensive monitoring in areas where the environment might be disturbed; and mining and milling should not start before such a monitoring system has been established. The Australian government should, the report says, have the power to suspend mining, perhaps at very short notice. □

This week

continued

Problems for NASA's new head

Peter Gwynne, New York



The space shuttle

Report recommends more research on smoking

A central unit to spearhead research on smoking and health is recommended by the Royal College of Physicians in its third report on the problem, *Smoking or Health*. The unit would undertake and co-ordinate research into methods of helping people stop smoking, less harmful forms of smoking, and means of identifying "high risk" smokers.

The tone of the third RCP report is rather more militant than previous ones, which were both called *Smoking "and" Health*. The evidence that cigarette smoking causes lung cancer, heart disease, emphysema, and bronchitis is overwhelming. But the report complains that "steps taken by government have remained paltry and hesitating," and goes on to make "a renewed call for more drastic action".

The smoking research centre is obviously seen by the RCP as part of this drastic action, it would not be just another academic unit. Past neglect of important areas of research into smoking makes the centre necessary. For example, no information about smokers' attitudes to their addiction has been collected in Britain since 1964, so education about smoking is based "more on the educator's opinions than on up-to-date knowledge". Further, "Relatively few government sponsored projects have been directly related to methods of reducing the numbers who smoke and exploring methods of helping smokers to stop". Only two such projects were supported by the 1971 joint Medical and Social Science Research Council advisory committee. A new joint committee set up

President Carter last week nominated Robert Froesch, a 49-year-old physicist from the Woods Hole Oceanographic Institution, as head of the National Aeronautics and Space Administration (NASA). Froesch has had plenty of Washington experience—he was assistant secretary of the Navy for research and development between 1966 and 1973—and he will need all of it to deal with the Space Agency's current problems.

One of NASA's lesser problems is a lapse in the schedule of testing the Space Shuttle. The second phase of the craft's flight tests was delayed from last Thursday to next week following a succession of minor delays. But major postponements of the programme seem unlikely at present. A much tougher problem is the agency's space science budget, which has suffered unexpected opposition from Congress during the past month.

The first blow came in May, when a House of Representatives subcommittee removed \$20.7 million from the forthcoming fiscal year's budget that was to

The success of the US's proposed reusable space shuttle—NASA's major project at present—will depend on the demand for its launch capability. In an effort to enlist customers, NASA is selling its wares at the Paris Air Show, which opens today (Thursday). Commercial companies and others are being encouraged to join the queue for space on the shuttle. Rockwell International, the shuttle's prime contractor, has a purpose-built calculator at the show. Potential customers can feed their needs into the calculator—which wants details such as desired orbit, and the payload mass and volume—which will then calculate how much a launch would cost.

The basic cost for the hire of a complete shuttle mission is \$10½ million at current prices. Additional requirements, such as the use of the interim upper stage that is being developed for the US Air Force to take payloads into a more distant orbit, could push the cost of a launch to \$20 million. The shuttle's 60ft long payload bay can also carry a number of smaller packages—space can be booked for as little as \$10 000. Major areas of interest in the shuttle, in addition to those which now use expendable launchers, include space manufacturing—producing ultra-pure vaccines and perfect crystals, for example—and orbiting privately owned communications satellites for use by large corporations.

in 1973 has not yet reported.

The RCP is equally critical of efforts to test methods of helping smokers kick the habit. In its 1971 report, it recommended that the Department of Health set up "smoking withdrawal clinics" and that the MRC should help the clinics to develop methods of helping smokers give up. By restating this suggestion with greater emphasis in *Smoking or Health*, which calls the clinics "essential", the RCP implicitly criticises the Department of Health for ignoring the 1971 recommendation.

As well as more research into methods of helping smokers give up cigarettes, the report would also like to see "much larger" studies on the effects of changes in tar, nicotine and carbon monoxide yields on health. For example, the report notes recent evidence that a nicotine yield of 1 milligramme per cigarette seems to be an optimum "fix" and suggests that no cigarettes producing more than this amount of nicotine should be permitted.

be devoted to the Jupiter orbiter probe (JOP). This is a programme designed to launch two spacecraft towards Jupiter in 1982, from which probes will fly into the Jovian atmosphere. Space officials fear that denial of funds for the next fiscal year might effectively kill the whole project, for the next launch opportunity will not occur until autumn and if JOP is lost the planetary spacecraft design team at the Jet Propulsion Laboratory in Pasadena, California, could be broken up for lack of work.

NASA hopes to get at least some of the cut restored in the Senate but there it faces opposition to another major project, the large space telescope, an optical instrument that the agency hopes to orbit with the space shuttle. Senator William Proxmire, who heads the Senate Appropriation Committee that deals with NASA funds, has long been sceptical of the NASA's space science projects arguing that the agency should concentrate on Earth-based programmes. Observers in Washington fear that if Proxmire cannot stop funding for the space telescope he will turn against the Jupiter orbiter probe.

Neither plan is yet dead, but Froesch and his staff will have a hard time convincing the politicians that both projects justify the money requested for them.

Neither plan is yet dead, but Froesch and his staff will have a hard time convincing the politicians that both projects justify the money requested for them. □

DES launches scheme to add maths teachers

The Department of Education and Science is acting to reduce Britain's shortage of teachers of mathematics, the physical sciences and craft, design and technology. Last week the DES launched a scheme to train extra teachers in these subjects. Nearly £4 million is to be made available to serving teachers, qualified teachers who want to return to teaching after a break in service, and mature graduates who would like to become teachers. Each will receive a basic maintenance allowance of £45 a week (tax free), with extra payments for dependents, travel, and lodging. According to a DES survey there was a shortage of 424 physics and chemistry teachers in 1976. The DES hopes to train up to 1200 people under the new scheme. The scheme is open to people aged 28 or over who have been away from full-time higher education for at least five years.

US planned to test chemicals on Mexicans

A division of the US Environmental Protection Agency (EPA) proposed to test possibly carcinogenic fungicides on Mexicans to bypass its own ban on human testing in the US. The fungicides are metal salts of EBDC (ethylene-bis-dithio-carbamate) and are widely used both in the US and UK.

EBDCs have been found to be teratogenic and carcinogenic in rats. The primary problem seems to be a decay product of EBDC, ethylenethiourea (ETU, $C_2H_4N_2S$). ETU has been found to be teratogenic in rats and rabbits and carcinogenic in rats and mice. It appears to directly affect the thyroid. ETUs occur as natural decay products—and thus contaminants—of EBDC; but they are also produced when EBDC residues on food are cooked and, most important, as metabolites of EBDC in rats.

The EBDCs are now undergoing a safety review in the US, which could

lead to a ban. In April 1975, the criteria and evaluation division of the pesticides programme of EPA proposed a study in which up to 1000 times the normal dietary level of EBDCs and 10 times the normal dietary level of ETU would be fed to Mexicans for between three and six months. The subjects would be monitored for only three months after the test—long enough to see early thyroid effects but not long enough to see any cancers which might occur.

The proposal for the Mexican study declared that although ETU has been identified as a metabolite of EBDC in animal systems, "no data have been uncovered with respect to the physiologic effects or metabolism of EBDC in man. The obtaining of scientific evidence on the effects and the metabolism of EBDC in humans is therefore essential in order to implement regulatory decisions."

Pesticide office head Edwin Johnson

rejected the proposal, and nothing was heard of it until last month when it was revealed in a newspaper interview with Jeff Howard. Once EPA's associate general council, Howard resigned last year with two of his staff "because EPA was not using its enforcement powers to regulate pesticides and toxic chemicals." EPA confirmed Howard's report, and EPA spokespeople privately call the proposal "outrageous" and admit it reflected "moral numbness".

Three of the EBDC compounds—Maneb (manganese EBDC), Zineb (zinc EBDC), and Mancozeb (a mixture of the other two)—are among the most common fungicides used on British farms, although they are apparently little used in gardens. They are primarily used on fruit and to control potato blight, but are also used on lettuce, spinach, and flowers. Total UK consumption is 1200 tonnes per year. None is manufactured in Britain: most imports come from Spain and France. □

Soviet dissidents seek paper support



A plea for western scientists to help dissident Soviet scientists by publishing their research results has come to *New Scientist* from biophysicist Yuri Vladimirovich Mnyukh. Mnyukh was a senior scientific worker, head of the laboratory of the physics of crystals at the Soviet Academy of Sciences' Biophysics Institute prior to his dismissal in 1973. He had supervised three "kandidat" theses (equivalent to our PhD), and had just completed his own doctorate thesis (Soviet "doctors" have the status of professors) just 10 days before his dismissal. The reasons for his dismissal are not clear, as Mnyukh told *New Scientist* he was by no means an active dissident. He mentioned that he refused to sign a statement concerning the secrecy of his work. The official reason given was the need for staff reductions at the Biophysics Institute.

He bases his plea to western scientists on his own experiences since 1973. All his efforts to get a job in his field have failed. As with all other out-of-work scientists, Mnyukh suffers the tremendous frustrations of not being able to continue his scientific work. There is no opportunity for continuing laboratory research, for taking part in scientific conferences, for spreading one's ideas, for defending them, nor for establishing priority. At the time of his dismissal he had begun publishing his ideas on phase transitions in crystals in a series of articles in the *Journal of Physics and Chemistry of Solids*. Three parts appeared—Mnyukh planned seven in all. Then the fourth was eventually refused, after an initial positive referee and eight months of toing and froing with Mnyukh carrying out numerous stylistic and other alterations requested by the publisher. Although part 4 finally appeared in another journal, Mnyukh is clearly bitter about this refusal. His was not, of course, a unique experience for a scientist, but it emphasised the difficulties of someone in his position. So far none of the final three parts—two on polymorphic transitions in crystals and one on ferromagnetics and ferro-electrics—has been printed.

Mnyukh told *New Scientist* that publication of the ideas of out-of-work scientists would be extremely helpful in raising their spirits and perhaps not unhelpful to science itself. It would also give the scientists a legal stick to point at the authorities when accused of parasitism.

Mnyukh now faces this charge. He was called in to the police in April and presented with "the warning of persons leading a parasitic form of life". This initial warning is often the first step before more formal legal proceedings. Mnyukh may be paying now for his recent entry into the more active fields of dissident politics. He joined the Helsinki Monitoring Group set up to monitor Soviet observance of the Helsinki Agreements, in January. □

Left Yuri Vladimirovich Mnyukh

This week

continued

New outlet for China's radical science

China's new attitudes to science could mean a radical change in the type of science and technology the country pursues. The official reports on the meetings called by scientists since the overthrow of the "gang of four" have mentioned high energy physics and genetic engineering, both formerly classed as "bourgeois" science, having no application.

Chairman Hua told scientists and technologists recently: "We must carry out scientific experiments conscientiously and train more scientists and technicians. We must say that the number of scientists and technologists in our country is small and their level of proficiency not high enough. We must not rest on the laurels of what we have achieved" (Hsinhua, 28 April).

China has just launched a new journal for scientists, *Schools of Natural Sciences in Contention*. The Chinese journal, which will be published twice a month, will allow scientists to air their views on sub-

jects outside their traditional disciplines. Traditionally, the Chinese science journals, including *Scientia Sinica*, devote several articles to current political issues—some issues have contained more politics than science. Presumably, the new publication will be devoted to discussions and critiques on social and political awareness and ensure that scientists, who are being encouraged to return to pure research, do not build any ivory towers. The magazine will also contain science articles on interdisciplinary topics; the first issue contained articles on the new hybrid strains of rice to be widely used in China this year, farm machine research, and discussions on the origins of biological cells.

Does this all mean that China will start buying vast amounts of sophisticated western know-how, on the road to "revisionism"? It's highly unlikely: apart from any political implications the problem of economic stagnation is as real in China as elsewhere. But obviously scientists are now expected to play a greater part in achieving economic recovery. *Christine King*

Daddario quits Office of Technology Assessment

Dan Greenberg, Washington

Against a backdrop of hostile sniping and the unflattering inauguration of a major examination of the agency he heads, Emilio Q. Daddario, legislative father and founding director of the Office of Technology Assessment (OTA), has announced that he plans to quit the agency by 1 July. Half-way through a six-year appointment, Daddario has long been on record as saying he would leave OTA as soon as he felt it had become well established in its role as a service agency for the Congress. Whether or not it has reached that status is a matter of confused and ample contention, but there is no doubt that, whether because of or despite Daddario, OTA has become the behemoth of the mysterious trade of technology assessment.

With about \$8 million at its disposal this year, the OTA boasts a staff of 140, about two-thirds of them professionals, plus hundreds of outside consultants. Its publication list is also formidable, ranging from a study of pharmaceutical bioequivalence to an assessment of the Internal Revenue Service's plans to track all incomes through a supposedly leak-proof nationwide computer system. It engages in studies that take years and it also serves as a fire brigade for hard-pressed Congressional committees—as with a hurried study it is conducting on saccharin. All this money, expertise, and activity would suggest a thriving outfit, the sort that was envisioned by director Daddario when he proposed OTA's creation back in the days when he was a member of Congress.

Critics think otherwise, and there are many of them. A couple of years ago, Caltech president Harold Brown—now US Secretary of Defense—relinquished the chairmanship of OTA's advisory council, charging that the agency was

dissipating its resources through scattered and ill-conceived studies. Brown was particularly miffed by what he considered to be a policy of ignoring the council that he headed. Various other barrages of more or less similar content were dropped on OTA by individuals and by assorted bodies of the Congress. Last year, the House and Senate made a symbolic cut in OTA's budget request as a signal of dissatisfaction.

Almost all the criticisms, however, have dealt with procedure rather than with substance. The measure of OTA's performance is the quality and timeliness of its studies, not the manner in which mail is internally routed and staff meetings are conducted.

So far, there has not been an authoritative, independent appraisal of OTA's output, but one may be in the works. The advisory panel which Brown formerly headed is now chaired by MIT president Jerome Wiesner, an old friend of the Kennedys. Senator Edward Kennedy, who chairs the board of Senators and Congressmen that oversees OTA, recently asked Wiesner to undertake a study of OTA's performance. The study, with a budget of \$50 000 for staff support and consultants, is generally interpreted as a slap at director Daddario.

Daddario's letter of resignation, addressed to chairman Kennedy, was cordial but brief, stating that the completion of several major projects "brings to an end the first phase of OTA activity which has been of a building and exploratory nature. I had always planned to leave OTA when that period of evolution had been reached". Daddario has not said what he plans to do when he leaves OTA, but as a lawyer, former Congressman, and first head of OTA he will have no difficulty finding employment. □

NASA delays ESA again

European space aspirations have had another setback following problems with an American launcher. Fortunately this time the rocket was damaged before the launch—of the European Space Agency's Orbital Test Satellite (OTS), an experimental communications satellite—so all that has been lost is time. The last failure was when the US National Aeronautics and Space Administration (NASA) put the GEOS scientific satellite into the wrong orbit (*New Scientist*, 5 May, p 254). OTS was due to be launched from the Eastern Test Range in Florida in the middle of June; but on the night of 17 May one of the booster rockets on the launch vehicle—a Delta vehicle, similar to that of GEOS—fell off and damaged the first stage which now has to be replaced. ESA now expects NASA to launch OTS on 8 September. Meteosat—ESA's meteorological research satellite—which was scheduled for launching on 15 September, has been put back to 3 November. □

Dog-collar shock probe

American dog owners can buy dog collars that give their animals an electric shock when they bark. The US Food and Drug Administration (FDA) has warned the 33 000 people who have bought these sound-activated dog collars—they are supposed to give their wearers a shock to deter them from barking—produce a voltage 10 times that stated on their labels. Such high voltages can burn dogs' necks and give a nasty shock to anyone who decides to grab a barking dog by its collar. The collars have been sold in the US for \$40 each, under brand names such as Wuf-E-Nuf and No Bark Collar. The FDA also found that other loud noises—another dog barking, a car hooter, and clapping hands, for example (it does not mention Concorde landings)—could also trigger the collars. □

Infested pest researchers

The London offices of the Centre for Overseas Pest Research have been hit by a pest of their own. COPR's experience with locusts, Nigerian grasshoppers, and Indian rice beetles, to name but a few, comes to nought when the domestic mouse moves in. COPR has been forced to call in a commercial pest-control firm to eliminate this infestation. □

THE NEW SCIENTIST

20 years ago

The present over-all position in the Gas Council's search for natural gas is that after somewhat disappointing results in Yorkshire, Lincolnshire, and Sussex—the Cousland well was drilled in 1938 and sealed off—operations are virtually at a standstill until a new programme is worked out. The emphasis has shifted from reliance on past evidence of the existence of gas to fresh survey work.

New Scientist, 30 May, 1957

Throwing light on planned obsolescence

Why do US lamps typically last two or three times longer than comparable lamps in Britain?

Why are the "long-life" lamps on the market not as good as they might be? Why is there no true competition between the big four British suppliers?

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is an engineer
researching planned
obsolescence

Many people suspect that manufacturers tend to adopt undesirably low standards of durability and reliability to cut costs and/or increase sales. There is evidence that, in the case of the UK lamp industry, this tendency not only exists but has had the most serious consequences. It seems that lamp lives in Britain are held down, and could and should be greater, and are much higher in America; that Philips at least is conforming in both markets; and that transatlantic trade is not what it apparently should be. It also seems that UK manufacturers have tried to disguise their restrictive approach by conniving at the availability of two long-life lamps which have been artificially handicapped.

This article deals only with discharge lamps, as opposed to filament lamps. But this should not be taken to mean that the situation regarding filament lamps is anything other than worse.

Discharge lamps account for an annual expenditure in Britain of £35 million—about £2 per household. Judging by lamp sales in the home market, the largest UK manufacturer is Thorn (Mazda, Atlas, etc), followed by GEC (Osram, etc), the Dutch multinational Philips, and finally Hawker Siddeley (Crompton). Similarly, the largest US manufacturer is General Electric, followed by Westinghouse and GE Sylvania, and then ITT, DuroTest, and the ubiquitous Philips. Ownership of the Mazda and Osram trademarks differs from country to country.

All discharge lamps depend on the radiation emitted by a gas-filled tube when a current is passed along it, the necessary electrons being alternately supplied by cathodes at either end. Both low- and high-pressure filings are employed, the latter resulting in much more compact but somewhat less efficient lamps. The gas may be mercury or sodium vapour. The mercury discharge emits both light and ultra-violet, which is ordinarily used to stimulate a phosphor coating to emit extra light. The more efficient sodium discharge emits light only, but of an unavoidably yellowish colour.

Most of these lamps employ cathodes coated with an emitter, a substance which emits electrons when heated. In operation, the discharge automatically raises the cathodes to a temperature sufficient to provide the emission rate necessary at the current peaks. At this temperature the emitter slowly evaporates, and its eventual exhaustion is usually the cause of lamp failure.

As a rule, an external (quite expensive) control circuit is required to start and stabilise a discharge lamp. Starting may involve a high-voltage pulse, or preheating the cathodes. Stable operation depends on the voltage applied to the lamp being reduced if its current increases, and is

achieved by connecting it in series with a resistor, or more commonly a choke (lag ballast) or capacitor (lead ballast).

The "rated life" quoted for lamps is usually a conservative estimate of the "test life" in standard conditions—the life in burning hours survived by half the lamps tested. Failing such conditions, the "actual life" obtained by the user may differ. The switching cycle is particularly significant, each start using up as much emitter as one or two hours of burning. So "indoor" lamps (fluorescent, etc) are usually rated at three hours per start, and "outdoor" lamps (sodium, mercury, etc) at five or ten hours per start.

Actual and test life may also differ because the industry has (sometimes correctly) persuaded some local authorities and others to practise "planned replacement" of lamps which have survived a certain "recommended" life—usually 66-100 per cent of the rated life—without waiting for them to fail. They argue that this allows bulk replacement, perhaps in conjunction with the cleaning schedule, and that the resultant savings in labour can more than justify the reduction in lamp life. They also, or alternatively, argue that as a lamp ages its light output tends to fall off ("lumen depreciation") for various reasons—chemical attack on the phosphor, blackening of the lamp wall by evaporated emitter, etc—so the electrical running cost per lumen tends to rise, possibly to a point where the lamp is effectively valueless and would be better replaced.

Longer lamp lives in US

In general, lamp lives in Britain could be increased—if only because the lives of comparable lamps are much longer in the United States. This is not due to the differences in mains voltage and frequency (240 V at 50 Hz in Britain and 120 V at 60 Hz in the United States). History, geography, and theory all suggest that the frequency difference cannot matter.

Nor can the voltage difference affect cold-cathode or sodium lamps, which require much higher voltages. As to the other lamp types, the common US wattages will run on 240 V but not 120 V; so large American users take a non-standard power supply (typically 240 V); otherwise, and more commonly, a step-up transformer is incorporated in the control circuit.

Given such a transformer, the lead ballast is cheaper to arrange than the lag type, and is normally preferred. However, lead ballasts actually shorten lamp life, distorting current waveforms so as to increase the peak current (cathode loading) somewhat. Thus, the higher UK voltage is in fact an advantage.

Demonstrating that lamp life should be increased depends on showing that this will not necessitate any change in lamp prices, efficiency or other factors which would cancel out its operating cost advantage. Improving life may mean using larger cathodes holding more emitter, and therefore increasing their cost and heat losses. Average efficiency may be further reduced unless lumen depreciation is improved in step with life, perhaps at additional expense.

However, doing this is not just a matter of simple comparison of the overall costs of US and UK lamps, or of improved lamps and their less durable predecessors—as these costs may differ for reasons entirely unconnected with lamp life. One reason in particular needs to be mentioned: efficiency can differ because lamp designers must sometimes arbitrarily balance it against "colour rendering"—

Table 1

Discharge	Lamp Types
Low-pressure	{ Mercury { Fluorescent (Hot-cathode, MCF) { Cold-cathode (Neon, Sign Tube) { Sodium (LPS, SO, SOI, SOX, SLI) { Mercury (MV, HPMV, MB, MBF, MA, MD, ME) { Blended-light (Tungsten-ballasted, MBT (F)) { High-pressure sodium (HPS, SON)
High-pressure	{ Mercury { { Sodium {

the spectral quality of the light produced.

The gap between US and UK life ratings appears to have resulted from the emergence of competition in the United States and its suppression here, suggesting that UK users would want longer lives if they could obtain them. However, it does not necessarily follow that they *should* have them.

If the only disadvantage of increasing life is a reduction in average efficiency due to lumen depreciation remaining the same—which is probably the case with fluorescent and mercury lamps—those buyers who neglect efficiency may insist on an undesirably long life, while those who do not will accept the lamp and practise planned replacement.

It is not in fact the solidarity exhibited by the UK manufacturers which suggests collusion, but rather the cracks which appear to have developed in it. The UK lamp industry used to maintain a completely uniform front on discharge lamp life (as well as price and efficiency). However, since 1963, long-life versions of mercury and blended-light lamps have been available from Crompton and GEC respectively. This development was not prompted by pressure from users, and the availability of these lamps has not been restricted in any obvious way. They have, nevertheless, made little impression on the market—presumably because both are so inferior in price and/or efficiency as to be uneconomic in comparison with the conventional lamp, except when replacement is awkward.

However, careful inquiry indicates that both of the long-life lamps have been "handicapped"—that their disadvantages are at least partly artificial. This circumstance, among others, strongly suggests that the widening gap between US and UK life ratings intimidated manufacturers in Britain into conniving at this situation for the sake of the impression it gives—that they do not and cannot restrict lamp life in their own interests. It seems unlikely that they would have adopted this strategy if their restrictions on lamp life could have been rationally defended.

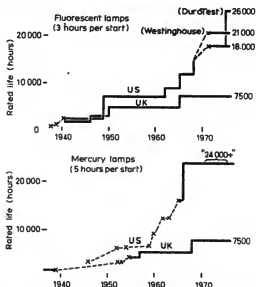
Fluorescent lamps The high efficiency of these familiar and very important lamps has allowed them to dominate ordinary interior lighting. However, their utilitarian appearance, starting delay, tendency to flicker and hum, and high installation costs have more or less excluded them from domestic and prestige use; and their temperature sensitivity, low output, and large size have equally excluded them from outdoor and high-bay factory use.

The usual UK and US fluorescent lamp and circuit arrangements do differ, but not in any essential respect. The associated life ratings are compared in Figure 1, and there is reason to think they do reflect actual lives. The new long-life US lamps are special Westinghouse and Duro-Test developments, the latter relying on the automatic switching in of auxiliary cathodes when the main fail.

The progressive rise in the normal US rating in the period 1961-72 reflects chemical improvements in the emitter used, while the 1965 increase in the UK rating merely reflects the adoption of a much earlier American innovation. British fluorescent lamps could therefore last at least 18 000 hours.

An increase in life would be desirable as well as possible. Its effect on lamp price would be negligible, judging by US experience. And since cathode heat losses would not be increased, its only effect on lamp efficiency would be the result of lumen depreciation. This is held by UK manufacturers to justify planned replacement at 5000 to 7500 hours, but American manufacturers have improved it in step with life to the point of being three times better.

Cold-cathode lamps Compared with conventional ("hot-cathode") fluorescent lamps, these are thinner, longer, less efficient and much less bright, and require much higher voltages (greater than 1000 V). However, they start instantly, can be easily dimmed, can be bent into shapes, and have longer lives which are not reduced by switching.



Accordingly, their principal application is the so-called "neon-sign". The main manufacturer seems to be the GEC subsidiary Claudgen.

The rated life of cold-cathode lamps was increased in 1948 from 6000 hours to 10 000 hours, and in 1953 to 15 000 hours. A small manufacturer then began to quote 30 000 hours, forcing GEC up to 20 000 hours in 1955 and then to an "agreed" life of 25 000 hours around 1957—a situation analogous to a price war—and finally resolved by a general retreat to 15 000 hours. It is not clear how users were persuaded to accept this.

In the United States, cold-cathode lamps were rated at 10 000 hours in 1945 and 1950, and are now available in 18 000-hour and 30 000-hour ratings. The more durable type is somewhat less efficient, but confirms that the British cold-cathode lamps could last at least twice as long.

Sodium lamps These familiar lamps have a much higher efficiency than any other, but give a saturated yellow light which does not allow people to discriminate colours. They are used for lighting traffic routes.

Their rated life was 2500 hours in 1935 but was raised to 3000 hours in 1946, then to 4000 hours in 1954, and to the current 6000 hours in 1963. However, the associated switching cycle is somewhat problematic and could even be three hours per start, so considerably longer lives might be obtained in actual use on five and ten hours per start. It is therefore particularly fortunate that in 1969-71 several users determined an actual life on 10 hours per start of about 10 000 hours.

In the US, the native product was rated at 4000 hours in 1940 but has since been discontinued. However, Philips markets a sodium lamp in the US, claiming 6000 hours in 1966, 15 000 hours on five hours per start in 1972, and 18 000 hours on ten hours per start since then. Therefore, as the control circuits are effectively identical to those in the UK, and as the sodium lamp has no advantages other than high efficiency and can only be sold to users who take efficiency into account, the UK lamp could and should last twice as long.

Mercury lamps These important high-pressure lamps combine filament lamp dimensions with fluorescent lamp efficiencies (almost) and are available with much higher outputs than either. On the other hand, they take several minutes to warm up, may be extinguished for a similar period by a momentary drop in mains voltage, and give a cold white light with an unfortunate effect on the human complexion.

Mercury lamps are preferred to fluorescent lamps in high-bay factories, where their higher outputs can be properly utilised; and are preferred to sodium lamps for street lighting in pedestrian areas—in fact, they dominate

street and outdoor lighting in the US and most countries other than Britain.

For at least ten years, Philips has been selling these lamps in North America as well as in Britain, conforming in both countries to the life rating conventional in each. These ratings are compared in Figure 2. There is some evidence for considerably greater actual lives in the US during the late 1950s, and in Britain during recent years. In fact, the modern UK mercury lamp might even last 15 000 hours, permitting planned replacement at 10 000 hours. But there is also evidence that the US lamp would last at least 50 per cent longer on a British circuit. Thus UK mercury lamp life could be more than doubled.

The non-availability of a short-life US mercury lamp suggests that lumen depreciation should provide the only economic limitation of lamp life, as does comparison of prices and efficiencies between the US and Britain. The lumen depreciation of the best US brand would justify planned replacement at 16 000 hours and therefore a test life of 16 000 to 24 000 hours, depending on the prevalence of planned replacement. So UK lamps should last longer, but not perhaps much longer.

In Britain, Crompton wholesales a long-life Westinghouse mercury lamp as well as the ordinary UK one. The long-life lamp was introduced in 1963 and has enjoyed little success, being sold at prices sufficiently high to render the UK product more economic. It employs an obsolescent phosphor which gives a colder and less acceptable light.

However, careful inquiry shows that Crompton and Westinghouse are sharing a quite excessive wholesale margin—at least 30 per cent—without attracting other and better US imports. The Sylvania lamp, for instance, is more efficient and employs a modern phosphor. If competitively imported, it would certainly sweep the UK market. One can only conclude that Crompton and Westinghouse must have some form of US co-operation in this.

There must, however, be more to the situation, because Crompton shows a distinct lack of enthusiasm for the long-life mercury lamp, in spite of the potential returns. Its catalogue not only provides all the information needed to prove that the short-life UK model is normally a better purchase, but even fails to mention the one consideration which might bring some users to a different conclusion—namely, the difficulties sometimes faced in making lamp replacements. In fact, the long-life American mercury lamp can be detected as such only by comparing its specification with that of the UK lamp, although the latter's "superior colour" receives a good deal of emphasis.

Such behaviour seems inconsistent with straightforward profiteering but is understandable if Crompton is really acting for the UK industry and primarily intends giving users the impression that the industry does not, and cannot, restrict lamp life in its own interests.

This may explain why Crompton continues to conform with the rest of the industry in all other respects; why Philips continues to supply most of the discharge lamps Crompton sells, at uniquely favourable prices; and why Thorn and GEC continue to supply Crompton with filament lamp components. Furthermore, the introduction of a long-life blended-light lamp by GEC in the same year might now look like more than a coincidence.

It is quite possible that the cooperation by the US lamp industry is paid for in kind. Fred Borch, the president of

General Electric from 1963 to 1968, once asked AEI to enter the US market because "it would look good to the Department of Justice [the anti-trust agency]". There are other indications that the once explicit international market sharing arrangements have merely gone underground—in particular, the continued existence of technical exchange agreements (between Thorn and Sylvania; Philips and Westinghouse; Philips and Crompton; and Philips, GEC, and General Electric).

Blended-light lamps These are mercury lamps in which the discharge tube is run in series with a filament inside the lamp envelope. This filament acts as the ballast, making a control circuit unnecessary, and also emits some light which is particularly useful because it improves the colour rendering and is available while the discharge tube is warming up. They are very inefficient and commercially unimportant—and are really just a more durable, plug-in alternative to the filament lamp.

In Britain, these lamps were rated at 2000 hours in 1953, and 3000 hours in 1960. Three years later, GEC broke ranks by introducing its present 8000 hour range, the other companies following up with 6000 hour lamps. In the United States, lamps corresponding to most of the British 240 V range are available, and for the same switching cycle of three hours per start were rated at 10 000 hours or 11 500 hours in 1972 (see Table 2).

So UK blended-light lamps could last longer, but should they? Information on US prices is difficult to obtain but those of the 6000 hour and 8000 hour lamps are the same, size for size. Efficiencies are compared in Table 2. Because of these efficiencies the 8000 hour lamps are invariably uneconomic, which explains (but does not justify) why the 6000 hour blended light lamps continue to be sold.

First, no conceivable adjustments for colour rendering and calibration could possibly reconcile the 10 000 hour US efficiencies with the UK figures, and calculations show that the 8000 hour efficiencies should actually lie between 98 and 99 per cent. Secondly, if a 6000 hour lamp can really be justified, it would be as saleable in the United States as it is here and would be available in the US, which it is not.

These facts further suggest, as does the 1963 introduction of both long-life types, that GEC is acting in parallel with Crompton by making a needlessly inefficient long-life lamp available. Is this part of the UK industry's restrictive approach to lamp life?

High-pressure sodium lamps These extremely expensive, yellow-white newcomers (introduced ten years ago) resemble mercury lamps in size and much else, but show insignificant lumen depreciation. They combine very high efficiency with very poor colour rendering, falling between their mercury and sodium rivals in both respects, and are therefore used increasingly for street lighting.

The UK range was rated at 5000 hours originally, and at 6000 hours (the present rating) in 1971. The US 400 W size was rated at 6000 hours originally and was uprated to 8000 hours in 1968, to 10 000 hours in 1969, to 15 000 hours in 1970, and to 20 000 hours (the present rating) in 1973. The less popular sizes have lagged a little, but were all rated at 15 000 hours in 1974.

If the UK rating is for five hours per start, it requires upward adjustment to be comparable with the US rating, which is for ten hours per start. Fortunately, one local authority using 400 W lamps on ten hours per start has found that the 1974 GEC lamp lasted 9000 hours. Astonishingly, it also found that the 1969 and 1971 Philips lamps lasted 20 000 hours and 27 000 hours respectively.

However, Philips supplies high pressure sodium lamps in both Britain and the United States, ostensibly conforming to the life rating which is conventional in each country, and importing them from Holland in each case. For simplicity in manufacture they could therefore be sending to

Table 2

Lamp	Rated life	Efficiency relative to 6000 hour lamp			
		100W	160W	250W	500W
UK	6000	100%	100%	100%	100%
	8000	72%	77%	85%	—
	10 000	—	112%	116%	—
US	11 500	—	—	—	118%

Britain what is in effect a US lamp, relying for repeat sales on the readiness of many local authorities to practise planned replacement at 6000 hours on the manufacturers' simple recommendation.

In any case, it is evident that Philips ought to rate its lamps realistically—in deference to the Trade Descriptions Act and its "competitive" status. Moreover, GEC (and presumably Thorn) could and should triple the life of its 400 W high pressure sodium lamp, and at least double the lives of its less popular sizes.

In conclusion, some of these findings are given further expression in Table 3, in which the ratings quoted are those now associated with the most popular lamp sizes. Present-day Continental, East European, and (some) Japanese life ratings seem to be broadly in line with UK rather than US ratings. Thus, the problem is not in any way peculiarly British.

As mentioned, the present superior lamp life in the US is apparently due to the emergence of competition there. But US manufacturers still find no difficulty in restricting US-UK trade and both history and logic suggest that real competition is too ruinous ever to persist for long in the heavily capitalised lamp industry. Indeed, it is possible that the restrictions which General Electric traditionally

Table 3

Lamp Type	Available Life Ratings (hours)		
	Normal	Other	America
Fluorescent	7500**	—	18 000-26 000
Cold-cathode	15 000*	—	18 000, 30 000
Sodium	6000*	—	18 000
Mercury	7500*	24 000	24 000+
Blended-light	6000**	8000*	10 500
High-pressure sodium	6000**	—	20 000

* Could and possibly should be improved.

** Could and should be improved.

imposed on the other US manufacturers using its all-important patent licences have been deliberately relaxed as an exercise in public relations. General Electric found itself, with Westinghouse, the object of a great deal of vilification following the discovery in 1960 that it had been rigging tenders for heavy electrical plant.

It has not been possible to show why UK manufacturers restrict life undesirably. Pressure on prices cannot be responsible, as customers are equally aware of lamp life. Could it be turnover which really interests them—for reasons involving empire building as much as profit? □

Why scientists don't cheat

Three competent biochemists spent four man years trying to repeat the exciting work of a PhD student.

Then he admitted that the data were figments of his imagination

Mike Muller is a freelance journalist specialising in science and development

A few dry letters to scientific journals over the past three months retracting a series of ten research papers are the only formal response to the revelation of that rare event, a full-blooded scientific fraud. The

papers concerned were the product of research carried out at Birmingham University's Biochemistry Department and the Max Planck Institute for Biochemistry in Munich by Dr Robert Gullis. According to a letter from him to *Nature* (vol 265, p 764), the extensive data in his papers was not experimentally determined, merely his hypotheses.

The letters fail to reveal the full scope of the apparently fraudulent work—originally regarded by some experts as a useful contribution to a number of areas of biochemistry. And they leave unanswered two important questions. Why did Robert Gullis start to report his hypothetical results? And, more important at a time when research budgets are being savaged, what can be done to prevent the repetition of an affair which has wasted time, money and effort as well as damaging the careers of several competent scientists?

With the help of some of those who have been involved, an account of the affair has been pieced together. It is a story which gives some insights into the pressures and complexities of current research but it provides no easy answers. The story begins at Birmingham University where Bob Gullis worked as a PhD student from 1971-1974. The research for which he eventually received his doctorate concerned the effects of various neurotransmitters and other substances on cell membranes derived from the brains of guinea pigs. What he apparently demonstrated was a system by which the physical nature of the cell membrane was changed by "messenger" substances on both sides of the cell wall.

Gullis's particular interest was the effect of various neurotransmitters (adrenaline, noradrenaline and 5-hydroxytryptamine for instance) and intra-cellular "messengers" (cyclic AMP and cyclic GMP) on the so-called Lands Cycle—deacylation/reacylation reaction involving the phospho-

lipids which are the principal components of the membrane and the enzyme phospholipase A2. The rate of this reaction, which could result in the substitution of different fatty acids in the membrane, could be expected to influence its physical properties—fluidity and ionic state for instance—and hence affect its cellular functions. What Gullis seemed to have achieved during his PhD work was to show that the rate of reaction was significantly affected by the various messenger substances.

The experimental technique he used was both sensitive and laborious. A typical experiment was described to me by Dr Mark Harvey who went to Birmingham, after Gullis had left, to develop his work. Each experiment lasted three days. The first was taken up mainly by the preparation of the membranes. To do this, a standardised technique is used which has been shown to produce consistent results. Brain tissue from freshly killed guinea pigs is first cut up, then gently macerated. A series of centrifuging operations then separates out the various cellular components and debris. By about 6 p.m. (after a 7 a.m. start) a "soup" of synaptosomes is obtained. These are cell-like fragments of synapses. The final separation of synaptosomal membrane is made by osmotically rupturing the synaptosome and further centrifuging the mixture.

At this stage, the enzymology is done to mimic the effect of a transmitter or other active substance on the membrane and measure its impact. To the tiny (10-100 μ l) samples of membrane, a buffer is added, then transmitter solution and a radio-labelled substrate for the reaction. Finally, after a few minutes, the reaction is killed by adding a methanol/chloroform mixture and dissolving the membrane lipids.

To study the reacylation stage of the Lands cycle, the rate of reaction could be measured using a substrate containing isotope-labelled fatty acids on an albumin "carrier" which could replace the missing acid on a hydrolysed phospholipid. After the reaction is killed, the phospholipid is extracted by chromatography (the second day's work) and the uptake of labelled fatty acid measured in a scintillation counter (on the third day).

There is no suggestion that Gullis did not carry out the lengthy procedures many times to produce reams of results using different combinations of active substances and buffers. At times, he was running three sets of experiments concurrently. The papers produced on the basis of his PhD work took up 33 densely written pages of *The Biochemical Journal* alone. It was only at the final scintillation counter stage that any fraud could take place. It is significant that this is where the fraud is alleged to have happened at the Max Planck Institute in Munich. There, Gullis was working with a team specifically measuring the levels of cyclic GMP produced in an artificial cell line by pharmacologically active substances as part of a broader programme of work.

"In some of the publications", wrote Dr Hamprecht, leader of the team, when retracting papers from his laboratory, "cyclic GMP was determined in the same samples in which cyclic GMP had been determined. The cyclic AMP assays were carried out by other members from the laboratory. But the printouts from the scintillation counter were left to Dr Gullis for evaluation" (*Nature*, vol 265, p 764). Fraud was suspected when staff at the Institute tried to repeat the results after Gullis had left. Several abortive attempts later, they asked him to return from the MRC's Mill Hill laboratories to repeat the experiment. And after four attempts in what was, by all accounts, a tense fortnight, he admitted having invented the results.

Could the deceptions have been detected earlier? Dr Harvey left Birmingham after six months, during which time he made several unsuccessful attempts to reproduce the most dramatic stimulation reported by Gullis, that of noradrenaline. While he was unhappy about his failure to obtain useful results, his departure was due as much to personal as to work reasons.

Was that the time to blow the whistle? The problem with biochemical procedures is that they take time to "work-in". Six months was arguably not enough. Gullis himself had taken some time to begin producing results. "It took me a good nine months to get the ball rolling," he told me. "I think I got nothing in the first six months." So from previous experience, some delay in obtaining results might be expected.

Non-repeatable results

Then another post-doctoral worker, Dr Steven Fisher, worked on the system for about a year, without success. And only in February of this year, nearly three years after Gullis had left Birmingham, did senior lecturer Dr Charles Rowe, Gullis's supervisor, write to *The Biochemical Journal* (vol 164, p 287) and say: "Dr Fisher and I have been unable to confirm some of the key observations reported."

According to Robert Gullis, there were queries from Birmingham about the problems encountered in trying to repeat the work. "I gave them all the advice I could," he says. "I remember one Christmas that I even offered to go up. I said phone me back if I should come and no one phoned me back. I presume they didn't want me to go."

In the event, it was the failure of the German team to reproduce Gullis's results that precipitated revelations of the fraud. Other events followed quickly. A letter was sent by Gullis to Dr Rowe stating that the data presented in the papers derived from his PhD work were not bona fide results of the experiments performed. Another two letters were sent to *Nature*, retracting all the papers relating to Gullis's work in Birmingham and Munich. Dr Rowe sent his letter to *The Biochemical Journal* almost simultaneously.

What does the balance sheet look like now? In Birmingham, a senior lecturer and two post-doc workers wasted perhaps four man years of an MRC grant working on the system from which Gullis claimed to get his results. In Germany, less time has been lost but Gullis's two-year tenure at least must be regarded as a write-off. There are less obvious costs. Gullis's Birmingham work was originally

regarded as a useful contribution to a number of areas of biochemistry. The original exponent of the Lands Cycle, Dr Bill Lands of the University of Michigan, himself said that the papers published by Gullis and Rowe were amongst the most interesting he had seen in the past two years. Other researchers have apparently decided the same—one item on the agenda at a recent meeting of *The Biochemical Journal*'s editors was what to do with papers awaiting publication which cite the Gullis and Rowe results.

There have been some positive results. In their attempts to repeat Gullis's work, Drs Rowe and Fisher made detailed investigations of the factors which could affect the experimental results. This, when published, could be helpful to other workers in the area. What one worker in the field fears, however, is that grant-giving committees will think twice before putting in more funds. This would be senseless he points out. The irony is that while present techniques do not reproduce Gullis's results, it is quite likely that they will in the future be repeated. They were, in a sense, expected—one reason why foul play was not suspected before. As Gullis says of his German work: "The literature is proving them all the time." And of the Birmingham results: "No one's done the same experiment but there is indirect evidence to support them."

What can be done to prevent a repetition of this unfortunate affair? For any fraud to be detected at the time of execution, someone would have had to check the printouts from the scintillation counters personally—a level of supervision that would be regarded as excessive for a post-graduate worker, paranoiac for a post-doc. The person in the best position to answer, Robert Gullis, is unwilling to discuss the details of what happened. He did, however, venture a few jaundiced comments on the structure of post-graduate education which may have some relevance: "Not once was I ever rewarded for my work. They were very happy with the results; they were just after results and were quite glad when someone was there working really hard to get them out and get a PhD at the same time."

During his time at Birmingham, he did not feel he had much support from his supervisor or the rest of the department. But as he himself says: "It's a problem you face everywhere. No one wants to bother too much with other people because they want to get on with their own work. This is silly for a university department because a university is a teaching place and a PhD is also a place to learn, a place to learn how to do research properly. And if proper guidance is not there, then there is something wrong with the whole system."

Dr Rowe, his former supervisor, is also reluctant to comment on the lessons that can be learnt. But he doesn't think more supervision is the answer: "I think if you work with anyone in scientific work, you have to take a certain amount on trust otherwise you may as well do all the work yourself." And of occasions when that trust is misplaced? "Fortunately I think they are very rare occurrences and this is a major tragedy."

Before calling for witchhunts, there is another aspect to be considered. The spectre of the unrepeatable experiments is one which must haunt many workers in a field which is technically as difficult as biochemistry. At this level, good work, bad work, right results, wrong results are not particularly helpful concepts. Repeatability is all. It is a long way from failing to repeat to calling cheat. Science would in no way be served if every time a result could not be repeated, the originator was threatened with exposure if he did not return and repeat the work.

The consolation for the scientific community is that this affair provides a clear answer to that question—Do Scientists Cheat? The answer must be, yes, occasionally they do. But there is a vital rider that if their work is at all important, any fraud will soon be detected. That, in essence, is why most scientists don't cheat. □

The ecology of tomorrow's water

What lessons have we learned from the British drought of 1976? And how can they be applied?

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When in doubt, consult the Oracle. Following last autumn's rains, which ended the driest 16 months in Britain since records began in 1727, the water industry has been taking advice on future climatic

prospects. In a world of uncertainty, the lot of the Oracle has not always been an enviable one. In classical Greece, the Oracle at Delphi cultivated ambiguity, and its modern counterparts continue to hedge their bets. "The Meteorological Office has been most helpful," the National Water Council (NWC) acknowledged in its recent report, *The 1975-76 Drought*, "not only in giving advice, but in discussing the derivation of that advice and discussing its limitations."

In attempting to secure a reliable supply from an intrinsically variable natural resource (rainfall), the water industry estimates the *reliable yield* of a water source—the average quantity of water it could supply continuously over a specific dry period. The NWC estimates that any reassessment of reliable yields in the light of last year's rainfall might involve a reduction of some 10 per cent. The "tentative" conclusion drawn by the water industry is that the "relatively dry weather experienced in the 1970s does not necessarily suggest that 'abnormal' departures from the historic pattern of average annual rainfall are to be expected more frequently in future in England and Wales". Thus it is "inclined" to continue using historical rainfall records (including the figures for last year) as a guide to the average rainfall, and the range of variation, to be expected in the future.

Even so, the uncertainties facing the industry are considerable. Certainly the accepted figure for average daily rainfall (84 000 million gallons) is, in principle, sufficient for UK needs. The reality of the situation, however, has always been rather less comfortable, with rainfall concentrated in the mountainous north and west, while the major demand comes from the east and south-east. The planning response to actual or potential water shortages inevitably has an impact on natural systems, particularly on those dependent on large inputs of water—such as estuarine wetlands. The immediate response to water shortage involves short-term measures such as increased abstraction from reservoirs, rivers and aquifers, and the introduction of water conservation policies. Longer-term responses include improved forecasting of water demand and supply, construction of new and larger reservoirs, the development of new storage techniques (such as aquifer recharge), and new management approaches (including river regulation and water transfers between different catchment areas).

Demand forecasting is a precarious task at best, especially if we simply extrapolate present trends into the future. Demand for water has been growing steadily in Britain, at some two to three per cent per year for many years, though there is no guarantee that that rate will not change. The Central Water Planning Unit, in a recent study, used national and regional consumption trends derived from a review of national records begun in 1961. It concluded that the demand for public water supplies would increase from the 1974 figure of 3200 million gallons a day to more than 5300 million gallons a day by the turn of the century—an increase of over 60 per cent.

Before the 1973 Water Act, the old Water Resources Board had investigated the possibility of some form of "national water grid", but ruled it out on cost grounds. The idea enjoyed a revival during last year's drought, and

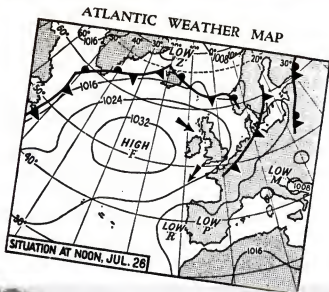
the National Water Council was asked to consider it in greater depth. The NWC concluded that the case for a national grid, while it would be feasible given time and resources, is weak. The water authorities, it suggests, will need to cultivate greater flexibility, tackling droughts as they develop. The Council also rejects the idea that detailed contingency plans should be prepared, in the belief that they would be both costly and ineffective. "Some pre-planning can be done," it argues, "but property and environmental interests are less likely to agree in advance to the sacrifice of aspects they wish to safeguard than they are to co-operate when the full severity of an occasional shortage is clear." Noting that public water supplies take about 8 per cent of the run-off of rainfall in an average year, the NWC feels that the main constraints on increasing water supplies are environmental and economic, rather than technological. While accepting the need for proper safeguards, the report emphasises that "it is not possible to give absolute priority to preserving the environment unchanged without putting the reliability of the water supply at risk".

Dangerously depleted oxygen

The ecological implications of that reliability—and of the matching of increased demand with increased supply—merit consideration. The ecological effects of short-term responses to last year's drought were monitored in some detail at the time. Abstraction rates insignificant during high flows suddenly became appreciable as river flows decreased. Nitrate levels posed a smaller problem than had been expected, with higher rates of denitrification occurring in the slower moving waters. But the combination of high temperatures, low flows, and the suspension of silt by high spring tides combined to bring dangerously low dissolved oxygen levels. At Tadcaster, for example, the river Wharfe, which contains a high proportion of brewery effluent, had to be specially oxygenated. So did the Derwent, below Derby, where a CEBG cooling tower was used to boost dissolved oxygen levels.

However, the ecological implications of longer-term responses to water shortages may well prove more significant. By disturbing sediment balances and damping out natural variations in river flow, dams tend to encourage vegetation at the expense of invertebrates—giving a more lowland character to upland streams and rivers. Among the management techniques under study, or already being implemented, are river regulation, inter-river water transfer, estuarial storage, groundwater abstraction, and aquifer recharge. River regulation involves the augmentation of river flows during low rainfall, either from groundwater sources and reservoirs (i.e. stored rainfall from the same catchment), or by transfer of water from other river systems. In a sense, such transfers represent an embryonic water grid, and a number of schemes are already in operation. Ecological studies are under way, or planned, on the regulation of the Welsh Dee; on the Tyne, Wear, Tees and Swale in relation to their regulation by the proposed Kielder Reservoir; on the Wye and Severn because a proposal to enlarge the Craig Goch Reservoir would allow both rivers to be regulated; and on the water quality and ecological changes to be expected if water were to be transferred from the Severn to the Thames.

Botanical surveys of the Severn have described the distribution of submerged algae, mosses and higher plants, and attempts have been made to divide the river into tentative zones based on the species identified. In headwaters and tributaries, electric current fishing has been



Reservoir, as have Liverpool University research workers in the Dee.

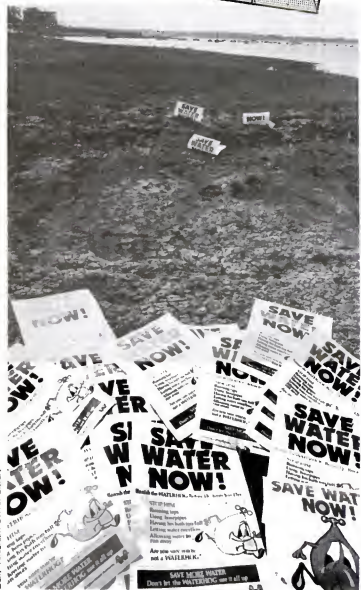
Regulation of a river can also affect its temperature regime. Reservoirs in a river's headwaters may remain warmer longer in the autumn, and heat up more slowly in spring, evening out temperatures downstream. Again, because regulated flows may be shallower than normal in winter, and deeper in summer, water temperatures will be depressed for considerable periods. As the hatching of the eggs of many species depends on water temperatures over a period of time, the result of regulation may be a mismatch between predator and prey species in aquatic food-chains, or between spawning and water depth and velocity. Regulation may also encourage siltation, where decreased flows fail to scour out a channel allowing silt to smother spawning beds and, in some cases, shifting the balance of fish populations from game to coarse fish.

Estuarine reservoirs may, on the other hand, affect internationally important wildfowl and wader sites. Exploitation of groundwater can also prejudice the fauna and flora of surface streams. The lowering of water tables has, in places, led to a drying up of chalk streams. Biologists from Reading University are studying chalk stream ecology, in the hope that their findings will enable predictions to be made about the effects of future groundwater abstraction. The artificial recharging of aquifers was another idea flushed out of obscurity by the 1976 drought. Theoretically at least, water from the Thames and other Thames Basin rivers could be used to replenish the storage in the strata underlying the Basin. These strata were depleted severely by pumping of boreholes and wells between 1800 and 1950. Experimental trials of aquifer recharge give considerable grounds for optimism. But, inevitably, full-scale recharging will divert water from natural systems downstream.

Given that such management techniques are being implemented already, and that ecologists are being asked to evaluate their effects, the lack of a comprehensive national survey of biological data must remain a considerable obstacle to progress. J. C. Peters, Head of the Central Water Planning Unit's Water Quality Division, argued recently that freshwater ecologists have no data source comparable to the Geological Survey or the Land Use Survey. Information is fragmented and often idiosyncratic, jealously guarded by the organisations or individuals responsible for the survey work. The most pressing need, he suggested, was for national information permitting the longitudinal zoning of particular rivers. Once-off ecological studies would be far more meaningful in the context of such data, and would permit more accurate prediction of likely changes.

Need for demand management

Before we all buckle down industriously, however, and start pouring out environmental impact statements on river regulation schemes, we should consider the place of demand management. In most industries, demand management is directed at increasing sales, but there is a body of opinion within the water industry which believes that they could be equally effective in reducing consumption. The various regional Water Authorities are in a significantly stronger position since the 1973 Water Act. And the 1976 Drought Act provided a permanently available range of powers which should be considerably more effective than those allowed under the 1958 Water Act. Since the Drought Act went on to the statute books, over 150 Statutory Orders have been approved. The large majority of these authorised new water resource developments. Only a minority were aimed at restricting consumption. C. J. Casserley, Head of the NWC's Information Services, argued recently that the savings in capital and interest costs to be had from an intensive 'Save It' media campaign could be of the order of £300-400 million over ten years. No need to consult the Oracle. You *know* it makes sense! □



used to establish what species are present, and in what numbers. The two most obvious threats to be quantified in assessing the ecological implications of inter-river transfers are the introduction of new predator species, and of new parasites or diseases. Researchers from Exeter University have studied fish parasites in the existing Craig Goch

Monitor

Leptomania

What is the world made of? Quarks and leptons. Quarks bind themselves into tightly knit groups of two and three to make protons and neutrons and particles like that. Leptons float about fairly freely, the electron sailing high above the nucleus of an atom is a lepton, while the nucleus is composed of quarks. Until recently it was thought there were only four leptons. But now leptomania has struck. There may be six. There may be seven. And—according to the latest interpretations of an experiment at Fermilab near Chicago—there may be eight leptons at the root of nature.

The Fermilab results are the fruit of a second look at the interactions of high energy neutrinos with quarks. A collaboration known catchily as HPFWR or the Cline-Mann-Rubbia group have found six events in which a high energy neutrino comes in, interacts with a nuclear quark in a target, and generates three muons. These six "trimuon" events may be evidence for two new leptons.

Two trimuons found by another Fermilab collaboration (*New Scientist*, vol 73, 24 March, p 697) appear to have a more sober interpretation.

The HPFWR group claim that their trimuons can best be explained if the neutrino interacts with the quark and turns into a heavy lepton with a mass of about 7 GeV (but unknown charge). The heavy lepton (they call it M) must then decay in two steps. First it decays into a lighter heavy lepton with a mass of about 3.5 GeV (they call it L), and a negative muon; and then that lepton decays into a positive and a negative muon.

The characteristic feature of the HPFWR trimuon events is that in each there is a pair of high energy muons, one positive and one negative, which emerge with a very small angle between them, indicating an origin in a single decay. The high energy of the pair suggests that it comes from the decay of a particle associated with the incoming high energy neutrino rather than the

stationary quark. In contrast the two trimuon events from the other Fermilab group can be explained by what may now be called a "conventional" idea; the decay of a pair of charmed particles associated with the quark.

Two independent papers in last week's *Physical Review Letters* support HPFWR's interpretation of their results; and one of them goes so far as to link them with the heavy lepton discovered in electron annihilation experiments (*New Scientist*, vol 74, 12 May, p 332; this heavy lepton has a mass of some 2 GeV). In this link there would be four new leptons: M-(7 GeV); M⁰(3.5 GeV); E-(2 GeV); and E⁰(less than 2 GeV). The new leptons can easily be accommodated in gauge models, but two nagging questions arise. If there are so many leptons how can they be elementary? And where are the extra quarks which, according to prejudice, should match the leptons in number? (*Physical Review Letters*, vol 38, p 1110, and 1183.) □

Tumour viruses infect us all

Tumour viruses may have disappeared from the headlines with the growing realisation that they cannot be called to account for most human cancers (if any)—but they certainly have not disappeared from the biosphere. According to research at the Imperial Cancer Research Fund Laboratories, most of us are probably infected with them (PNAS, vol 74, p 1237).

The viruses in question are so-called type-C viruses, whose genetic blueprint consists of RNA rather than DNA like

everyone else's. However, RNA viruses are famous for their ability to make DNA copies of their genes which they can insert into the DNA of the host cells they infect. In animals, the possession of RNA virus DNA can cause a cell to become cancerous, but there is no evidence that this happens in humans.

On the other hand, infectious C-type viruses have now been recovered from the cells of human leukaemia patients. And one of the questions immediately raised by that discovery is how did they

get there? In animals, there are two possible modes of transmission: infection, which is known as horizontal transmission; and by inheritance of the integrated DNA, which is passed down in the germ cells from parent to offspring and is known as vertical transmission.

Bernard Kurth, Natalie Teich, Robin Weiss and R. D. T. Oliver have now found that 39 normal healthy people whose blood they tested have antibodies against at least two kinds of type-C virus, which implies that the viruses are transmitted by infection, and that they are very widespread indeed.

They tested viruses from several sources: human leukaemia viruses, baboon viruses, and viruses from mice and birds, using a very sensitive technique (radioimmunoassay) for detection of antibodies in the blood samples. They found antibodies that reacted with the human and the baboon viruses, and weakly with the mouse virus. It is not surprising that human antibodies should react with a mouse virus, since the type-C viruses from different species are known to be related. The closeness of the relationship between the viruses corresponds roughly to the closeness of the evolutionary relationship between their hosts. Now the question is, if infection with type-C viruses is as common as Kurth's results suggest, do the viruses do any harm, and are they involved in any way—even indirectly—in causing cancer?

Tumour virologists have become careful to the point of paranoia about guessing at the broad significance of their results, so Kurth and his colleagues refuse to speculate. But the fact that they and several others now have their sticky fingers on real live human type-C viruses means that if the viruses are involved in disease, they have the means to begin thinking about developing vaccines. □

Whistle, and the ladies drop their eggs together

The synchronisation of the oestrus cycle of the female is not restricted to the overworked case study of nurses living in hostels. Bitch dogs housed together invariably come into "heat" together, and this synchrony is thought to be mediated by pheromones (externally communicated hormones). Susanna Viljoen of the Mammal Research Institute University of South Africa has recently reported a fascinating variation on this theme.

The African bush squirrel (*Paraxerus cepapi cepapi*) lives in family groups of a distinct and defended territory. The female utters a rather piercing whistle when she is about to ovulate, and this sound attracts not only the male of the particular group, but also those from all surrounding territories who take part in a mating chase, the lucky winner supplying the genes for that year.

Observation of the animals in the wild shows that the oestrus whistle in one female results in synchronised births later in the year, implying that when one female is ready to mate, so are all the rest in the group. Could it be the whistle itself which triggers the oestrus of the



other females?

To test this Viljoen captured animals and took them to the Institute, where their whistles were recorded on tape. Sure enough, within a day or so of hearing the vocalisation, either "live" or recorded, the females went into synchrony, and produced their own male-attractant whistles, too. The mating call presumably triggers some internal hormone surge which in turn triggers ovulation.

This is the first report of breeding synchronisation in a mammal triggered by a mating call. Why it should be so is open to speculation. Viljoen suggests that synchronisation of the births in the family group mean that in the annual food shortage in July and August, all the young are at the same age, and so have an equal stake in the food battles which occur (*Journal of Reproduction and Fertility*, vol 50, p 125). □

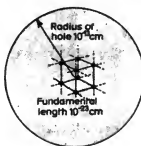
Black holes test for fundamental length

Is there a fundamental length in space and a fundamental unit of time? Or are space and time infinitely divisible? Two Russian physicists, V. L. Ginsburg and V. P. Frolov of the Lebedev Institute of the Soviet Academy of Sciences, have argued that the best evidence of divisibility would be the discovery of a mini-black-hole. The existence of a hole of 10^{15} g would set an upper limit of 10^{-23} cm on the fundamental length, the authors argue.

The limits, without the aid of black holes, are that the unit of space must be smaller than 10^{-15} cm (one hundredth the diameter of a proton) and the unit of time less than 10^{-25} seconds. These limits were established in high energy physics experiments which involved testing the theory of quantum electrodynamics—"QED", the quantum theory of electromagnetism—at the highest energies. QED relies on space and time being continuous, and would break down at high energies if it were not. In quantum physics a high energy probes short distances: roughly a collision at 1 GeV is sensitive to scales down to 10^{-13} cm, 10 GeV to 10^{-14} cm, 100 GeV to 10^{-15} cm, and so on.

Thus the few hundred GeV muon beams at Fermilab (and shortly at CERN) test for fundamental length anomalies in electromagnetic interactions down to a scale of about 10^{-15} cm (and a time equal to the time light takes to cross such a distance). To reach the 10^{-23} cm limits that might be set by mini-black-holes would require muon beams of 10^{19} GeV, inconceivably high for accelerators.

How do mini-black-holes succeed where accelerators fail? A typical mini-black-hole might be one with a mass of 10^{15} g (about the mass of a mountain). Large numbers of such small holes may have been formed at the beginning of the Universe, in some cosmologies. According to Stephen Hawking, the Cambridge theorist, "black" holes steadily convert



Mini-black-hole mass 10^{15} g

If mini-black-holes of 10^{15} g mass are found they will set an upper limit of 10^{-23} cm on the granularity of space-time, argue two Soviet physicists

their mass into radiation, getting hotter and hotter and radiating faster and faster. This acceleration continues until finally the black hole disappears in an explosion of gamma rays. Black holes with a mass of 10^{15} g, formed in the Big Bang, should be reaching the explosive stage about now, and their death-throes could well be visible to astronomers.

Ginsburg and Frolov, writing in *Pis'ma*

Stars may be making black holes right now

Mini-black-holes may be forming right now inside neutron stars. This novel conclusion is reached by Ken Jacobs and Patrick Seitzer of the University of Virginia, who reject the notion that mini-black-holes can only be made in the early Universe. If their prediction is correct, challenging new fields in imaginative astronomy are opened up.

Most papers on black holes (those warped regions of space from which light cannot escape) deal with entities of stellar or galactic mass. Stephen Hawking injected some variety with his idea that mini-black-holes in the mass range 10^{-3} to 10^{15} g might also exist. These have the astonishing property that quantum fluctuations cause them to evaporate until

v. Astronomicheskoy Zhurnal, vol 2, p 474 now argue that connected with a fundamental length, l , is a characteristic (and very high) density $\rho = h/c l^3$, where h is Planck's constant and c the speed of light. The authors believe that this density sets an upper limit to the possible density of matter. Now the density of a classical black hole, for mass M , is of the order of c^4/GM^2 (where G is the Newtonian gravitational constant). The density of a black hole thus increases as its mass decreases. The maximum density set by the fundamental length thus sets a minimum mass for a black hole.

The minimum black hole mass works out to be $10^{15}/(10^{-23})^3$ g, so if the fundamental length is larger than 10^{-23} cm, 10^{15} g black holes cannot exist. Conversely if a black hole of mass m is discovered, it will imply an upper limit to the fundamental length of 10^{-23} cm ($m/10^{15}$ g). Stellar mass black holes, of order 10^3 g, will only set a limit of 10^{-14} cm, one order of magnitude less stringent than existing limits using QED. But the discovery of substellar black holes, of 10^1 g and below, would begin to improve on our knowledge of the atomicity of space-time. □

they finally disappear in an explosion. Theorists consider that only the hot early Universe can be conducive to the manufacture of these black holes.

Not so, argue Jacobs and Seitzer in *General Relativity and Cosmology* (vol 8, p 7): "We contend that mini-black-holes are forming today in the centres of some stellar mass objects". They discuss the following formation mechanism.

If a neutron star can capture extra mass, as indeed happens when one is in a binary star system, the central pressure and density must increase to sustain the extra material. Should the density rise fast enough then the core can independently become a small black hole. This contracting central section will suddenly find that it has slipped through the black hole horizon. Now it is physically cut off from the surrounding stellar envelope.

The interaction of the black hole with its environment leads to a rich variety of phenomena. Accretion of the envelope onto the mini-black-hole will eventually make a classical black hole as massive as a star. Alternatively, if Hawking evaporation is rapid, then the formation of big black holes is actually prevented, and even massive stars can eventually settle down as white dwarfs.

The most speculative and spectacular scenario occurs if a black hole is capable of eating up the rest of the star in only a few milliseconds. Such an event liberates a burst of 10^{14} Joules of energy instantaneously. This will look like a supernova outburst and will be accompanied by a plethora of ultra-energetic particles. Perhaps these events are responsible for the flux of high-energy cosmic rays? □

Guanine keeps a fish blown up

If, like fishes, you spend a lot of time moving in water, you would find it an advantage to be able to float at any depth without constantly expending energy. Sharks make an effort in this direction by packing their liver with oil, but they still sink to the bottom if ever they stop swimming. Most other fish have solved the problem by inflating a small "balloon", the swim bladder, inside the body.

These bladders probably evolved from the lungs of air-breathing fish, but the gas is no longer gulped into the bladder, it is actively secreted by a gas gland. To prevent collapse of the bladder the pressure inside has to be raised to well over one hundred atmospheres. Now secreting gas into that sort of pressure is no picnic, and the fish had to have a way of keeping it there, once secreted. It

needed a biologically available tissue that was gas impermeable and yet flexible.

George Lappenans and Knut Schmidt Nielsen of the Department of Zoology, Duke University, have recently found the fishes' solution. The middle layer of the swim bladder wall alone is responsible for the gas-tight properties of the organ, and its secret is a very thin layer of crystals of guanine (one of the DNA bases) layered in strings, parallel to the wall. Though incredibly thin, this layer is about 100 times more gas-tight than mammalian collagenous connective tissue. This layer, coupled with a counter-current gas exchanger in the blood supply to the bladder, keeps the swim-bladder at pressure with the minimum effort from the fish. (*Journal of Experimental Biology*, vol 67, p 175). □

Monitor

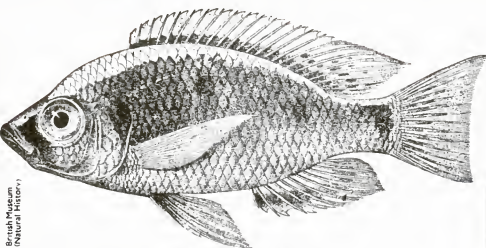
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Cuckoo fish

Among fish, some of the best parents are found in the family Cichlidae. Very many cichlids are mouth-brooders: the female takes the fertilised eggs into her mouth and broods them until the fry hatch. She then releases the little fish at some suitable spot and stays on call to guard them. When danger threatens she recalls her brood to the safety of her mouth, although as time passes the fry no longer respond to signals and the association ends. A. J. Ribbink, of Rhodes University in South Africa was diving in Lake Malawi when he noticed that some of the cichlid broods contained a mixture of offspring; some were clearly the true offspring of their maternal guardian, but others were equally clearly alien interlopers. It seemed that an underwater cuckoo was at work.

There were three species with mixed broods, and during a ten-day survey period none of these species was seen with a pure brood. A mixed brood was caught and reared, and the cuckoo identified as *Haplochromis chrysnotus*. The problem is that the cuckoo is a surface living plankton feeder while the surrogate parents are bottom living predators, and somehow the fry must be transferred to their foster parent. It is possible to get a cichlid mother to accept interlopers provided they are very similar in age, size and behaviour to her own progeny. So the cuckoo fish has to find a mother whose brood is at a similar stage of development and mix her brood with them. Once the broods are mixed it would be very hard for the foster mother to separate them as both sets of fry respond to the recall signals and she couldn't risk trying to eat only the interlopers.

There are other problems too. Cichlids imprint on the species that raises them, generally preferring that species to mate with, yet the cuckoo apparently breeds true. Is it resistant to imprinting, or does



Haplochromis chrysnotus—an African fresh-water fish reared in the mouth of another species

it form its attachments very quickly, before being hived off on the foster parent? And why have the foster parents not developed some sort of defence

against this form of parasitisation? There are many questions still to be answered about this fascinating fish (*Nature*, vol 267, p 243).

Fireballs photographed in Lincolnshire and Isle of Man

Two fireballs ('shooting stars' caused by interplanetary debris colliding with the Earth) have been photographed by the British fireball network in the last few weeks. Fireball networks attempt to track the falling bodies and collect the debris, and the recent photographs are among the best taken in Britain.

In the first of the new observations, at 22.01 GMT on the evening of 28 March, a magnitude -10 fireball descended into the Earth's atmosphere over Lincoln. Network camera stations in the area recorded the event. One at Waddington, Lincolnshire, collected the best pictures as it was almost exactly under the fireball. The fireball first became visible at just over 60 km height, travelling at 12.9 km/s steeply downwards, and after 2.6 seconds of flight, faded out at only

31.6 km having decelerated down to only 7.5 km/s.

The photographs of the meteor trail show no flares, which occur when fireballs break up; so it seems that this was a hard stony body. The low entry velocity, minimising drag forces, the steep angle of entry, minimising mass loss due to ablation, and the strong body structure make the fireball a good candidate for a recoverable meteorite fall. However, initial study suggests that the body's mass of about 65 kg may not have been quite enough: the remaining body may be too small to detect.

Nevertheless this is the first deeply penetrating stony body to be photographed well by the network since the Strathpeffer fireball of 14 December, 1974, which penetrated down to 28.1 km. Here the high entry velocity of 38.4 km/s and small initial mass of only 11 kg led to a terminal mass of less than a gram. The Lincoln fireball body had a short period orbit very similar in general shape to the paths of the Innisfree (Alberta) and Lost City meteorites—the only two meteorites to be recovered by fireball networks to date.

In the second observation a bright flaring fireball appeared over the north-west Irish Sea just before 2 am on the morning of 7 April. It was particularly well photographed from the Isle of Man. Entering the atmosphere at a shallow angle the fireball steadily brightened to about magnitude -10; but at just under 50 km height, drag forces must have exceeded the strength of the 90 kg boulder. In three tenths of a second it disintegrated completely in two prolonged flares brighter than magnitude -11. Such behaviour is depressingly common among fireballs, the majority of which destroy themselves and do not lead to meteorite falls.

Blocking natural opiates leaves you anxious

The discovery that the brain contains its own natural opiates, the endorphins, has led among other things to a fresh look at the effects of opiate antagonist drugs. Opiate antagonists are generally used in the treatment of drug addicts, and anything a junkie says about his or her feelings of tension and pain is open to a hundred questions. However, if opiate antagonists work by blocking the brain's opiate receptors, then they should block the effects of the natural opiates; and since the opiates reduce pain and anxiety, antagonists should increase them. Accordingly, Priscilla Grevert and Avram Goldstein took a dozen perfectly normal volunteers and inflicted pain upon them in order to test the effect of the opiate antagonist naloxone (*PNAS*, vol 70, p 1291).

The pain was caused by exercising the arm with a tight tourniquet wrapped round the forearm. The working muscles

were thus deprived of blood and exercise in those circumstances causes what is known as ischaemic pain. After 10 minutes, or when the volunteers begged for mercy (whichever happened first), the tourniquet was released. Pain sensation and mood were checked for each volunteer throughout and duly recorded. All the volunteers were given injections, but only half of them were of naloxone. The others were a harmless salt solution—and the volunteers were not, of course, told which of the two they had had.

It turned out that naloxone did not affect pain—but it did prevent the relief of anxiety that usually followed the removal of the tourniquet. Why it should affect pain but not pain Grevert and Goldstein do not know; possibly, they suggest, higher doses may be needed to influence pain; or the pain and the anxiety systems may be independent.

Lasers deep in the ultraviolet

Experimenters smash record for lowest laser wavelength

The laser, through its conventionally contradictory qualities of precision and power, has resurrected atomic physics from the dead: it seems that every week brings a spate of new and exciting discoveries. One of the greatest concerns is to extend the range of wavelengths in which lasers will operate—particularly at the short wave end—and lasers have now been developed that operate far down into the ultraviolet.

The shortest reported wavelengths have been achieved by a group at the Naval Research Laboratory in Washington D.C. using the technique known as harmonic generation (*Physical Review Letters*, vol 37, p 1540). The sheer number density of photons in a laser pulse can force irradiated atoms to absorb two or more photons before any reemission occurs. The atomic electrons are pumped up stepwise to a highly excited state and when they do drop down again, they emit their accumulated energy as a photon of half (or a third . . .) of the original wavelength. If enough electrons can be pumped into the excited state, a population inversion at this level can be obtained, and a frequency doubled (trebled . . .) laser can be created.

The NRL group started with a Nd-YAG laser, which produces very intense pulses of radiation at a wavelength of about 1060 nm. They frequency-doubled this beam twice, first by passing it through KH_2PO_4 and then through KD_2PO_4 , producing a beam of wavelength 266.1 nm. The final stage was to pass this beam into gaseous neon, and generate the fifth harmonic, that is, to get a laser operating at $266/5 = 53.2$ nm. The generation of such high harmonics is an extremely inefficient process, but the NRL group improved their chances by choosing to work with neon. Neon has an excited level that corresponds to the absorption of four of the photons used. There is therefore resonant absorption of these four photons, improving the overall efficiency (see figure 1). The NRL group has now gone on to use helium as the generating gas instead of neon. Helium's big advantage is that it is much harder to ionise than neon. The neon atom, after absorbing five photons, is so excited that it has enough energy to ionise. The pressure in the gas must therefore be kept low to prevent losses through such ionisation, and this reduces the efficiency of the laser.

The NRL team have now reported that it has been able to generate the seventh harmonic of the pulse frequency, to obtain a laser working at 38 nm (above the ionisation level for helium, even). They have, in effect, collapsed 28 photons from their primary Nd-YAG laser into one ultraviolet photon.

A team at Imperial College, London, led by Professor Daniel Bradley, has been developing a more subtle approach to the problem, (*Proc. Loen Conference 1976*, Springer Verlag, p 40). They start by

firing a pulse of electrons into gaseous xenon. In the resulting profusion of atomic processes, short-lived Xe_2^+ molecules are formed, whose radiation makes a laser working in the vacuum ultraviolet at about 1700 nm. As a lasing agent, this xenon excimer has a number of advantages. First it is already in the ultraviolet, thus obviating the inefficient frequency quadrupling necessary with the Nd-YAG laser. Secondly, the de-excited xenon molecule is unbound. After it has emitted its radiation, the molecule dissociates to atomic xenon. This greatly diminishes the possibility of reabsorption of the laser photons, and enables high gains and powers to be achieved. The third major benefit is that the instability of the xenon molecule broadens the spectrum of the emitted light. The energy depends continuously on the separation of the xenon atoms at the instant of emission (see figure 2). By careful design a particular wavelength can be picked out from this spectrum and the laser can be tuned.

By choosing to work at 171 nm, the Imperial group used a two-photon resonance in argon to generate the third harmonic, and thus a laser operating at 57 nm. Again because of its ionisation

properties, they are switching to helium, and hope to generate the fifth harmonic of a 175.2 nm laser, giving a wavelength of 35 nm. Their ambition is eventually to use Li^+ ions as the generating medium, when wavelengths of less than 10 nm should become possible.

Of even greater, but as yet unfulfilled, potential is the free electron laser recently developed by a team at Stanford University (*Physical Review Letters*, vol 38, p 892). Fast electrons fired into a target slow down by the emission of "Bremsstrahlung". In effect they collide with the electric field of nuclei, and in bouncing off they radiate light. The shape of the Coulomb potential is reflected in the wavelength distribution of the Bremsstrahlung spectrum. The Stanford team constructed a large helically wound superconducting magnet which generates a transverse, spatially periodic field (see figure 3). Fast electrons bounce from this just as they would from a nuclear potential, but there is a crucial difference: the large-scale periodicity of the field causes the Bremsstrahlung to be monochromatic. Just as with excited atoms, therefore, one has an excited system that radiates at a particular frequency—and can be stimulated to form a laser.

There are two great advantages to the free electron laser. The first is that its wavelength can be chosen at will. It is directly proportional to the wavelength of the applied magnetic field and depends inversely on the square of the electron's energy. The more energetic the electron, the lower the wavelength of the radiation. So far a wavelength of 3417 nm has been achieved, but the Stanford team calculate that with existing accelerators they could get down to wavelengths of 120 nm.

The other great advantage of the free electron laser is its inherent efficiency. By putting their magnet in an electron storage ring and reaccelerating the electrons after every traverse of the magnet, the Stanford team also estimate that they might get a 100 kW laser to operate at 50 per cent efficiency. Compare this with the 1 per cent maximum currently achievable with tunable lasers. If lasers are to be commercially viable such efficiencies will be necessary.

What could they be used for? Molecular bonds have energies mostly corresponding to ultraviolet wavelengths. These lasers may therefore be able to do for molecular physics what dye lasers have done for atomic physics. Professor Bradley also suggests that ultraviolet lasers could prove their worth in the etching of chips for the next generation of microprocessors, the construction of X-ray diffraction gratings and holographic systems, and as a "magic bullet" for the destruction of specific, unwanted molecules in microsurgery. Their real use will probably come from applications that we cannot as yet even imagine.

Martin Goldman

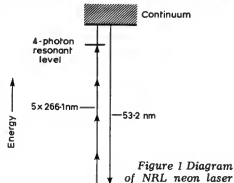


Figure 1 Diagram of NRL neon laser

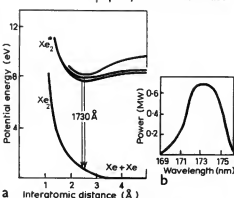


Figure 2 a Energy—distance curve for Xe_2^+ ; b tuning efficiency of laser

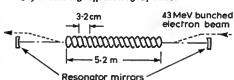


Figure 3 Stanford helical magnet



How much light do animals like?

Allowing various animals to alter light levels at will reveals that they have sharp preferences that are admirably suited to their way of life

Lee Kavanau is professor of biology in the department of biology, University of California, Los Angeles

Give a squirrel, a fox, a monkey, or other animal the means to "engineer" its environment, and what will it do? Will it seek variety? Will it have sharp preferences? Or will it be indifferent?

Though these questions may sound unusual, I've been asking them, in one form or another, of scores of animals for almost two decades. The answers have been loudest and clearest in matters of ambient light.

In an early experiment, I allowed four captive deer mice to control their light environment by pressing levers. If the animal pressed a lever on one side of its exercise

wheel (Figure 1) the light brightened one step, while a lever pressed on the other side dimmed it a step. There were 10 steps in all, from darkness to 40 lux (about 200 times as bright as the full moon). The mice quickly used their new-found power, changing the light enthusiastically up to 170 times a day (Figure 2). Typically they ran rapidly back and forth between the levers, brightening and dimming the light. Sometimes the levers were scanned in only fractions of a second. But after indulging in the novelty of continuously sampling the entire light range, the animals soon developed strong preferences. They settled into consistent selection patterns in which they were most active (time spent running the wheel) in intermediate dim light, roughly equivalent to a clear moonless night; as deer mice are commonly active in this range of intermediate dim light in the wild, their lever-pressing preference was consistent with the thesis that they see best in this range.

These results were provocative. It occurred to me that perhaps I could use this voluntary light-control technique generally to assay the overall state of adaptation of the visual system. No experimental behavioural assay had been available previously, although there are psychophysical tests for specific facets of vision, such as sharpness of light and colour vision. But as far as assessing general adaptiveness, we have depended almost entirely upon inferences from the gross morphology of eye, the microanatomy of the retina, and observations of behaviour in the wild. The latter approach is unreliable for animals with duplex vision, that is having appreciable numbers of both rod cells (for vision in dim light) and cone cells (for vision in bright light and sharp sight). The vision of these animals is usually highly versatile, so that their visual ability is not the chief factor limiting their times of activity.

In addition to strong light preferences during activity, one of the four mice studied had an even stronger preference during inactivity: it turned the light off before periods

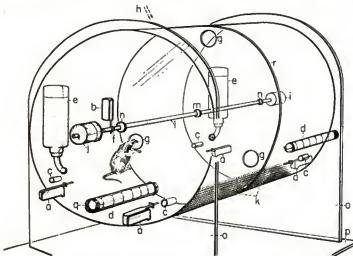


Figure 1. Running-wheel enclosure used in the study of deer mice: a, control switches; d, food guns; e, water bottles; g, passageways in centre pane; h, position of light sources; i, tachometer generator; r, centre pane.

of rest and sleep. So the test also promised to tell me how much light animals prefer when they are inactive. Since this early work I have determined the preferences of a wide variety of mammals. We had expected fairly straightforward results, judging from the findings with deer mice, but each study produced surprises.

Roy Havenhill and I began by surveying eight species of chiefly nocturnal rodents and a mouse opossum. Five of these species lived up to expectations, preferring specific dim light ranges during activity. The other four species provided the surprises. The gopher and mouse opossum preferred total darkness, while two meadow vole species had dual preferences—for both dim light and total darkness.

Underground preferences

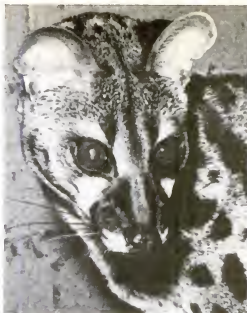
How can one account for the fact that the mouse opossum and gopher preferred darkness instead of dim light? One might be tempted to conclude that gophers prefer total darkness because they spend almost all their time underground. But active mouse opossums rely heavily on their eyes, so we had to look for a different reason. The explanation for all four species may be that it is biologically sensible for them to do some things in darkness simply because it is generally safer not to be seen.

In our laboratory experiments none of the tasks the animals did required them to see well. So it really should not be surprising that animals which are well adapted for life in the dark (having good senses of hearing, smell, and position, and possessing whiskers and a good memory of surroundings) prefer darkness in the laboratory. Perhaps we should be surprised, rather, that all nine species did not prefer darkness, as all of them are probably well adapted for activity in the dark. The dual preferences of the meadow voles may then be an expression of competing tendencies to spend time both in the light range in which they see best and the range in which they are safest. At any rate, the mere fact that almost all species preferred particular mid-dim ranges of light supports our assumption that it is meaningful to ask the question "what is the light range in which vision is best?" at least for small nocturnal mammals (with almost exclusively rod retinæ).

This second group of animals also gave us evidence of specific light preferences when they were inactive. The performance of eight of the 20 individuals shifted to dimmer levels during inactivity. For three of the eight, a California mouse, a desert woodrat, and a meadow vole, there were marked shifts to darkness. We suspect that the reason some individuals did not prefer darkness when they were not active was that they did not learn to express the preference during this phase. They just left the light at the level it happened to be at when they retired.

Greater surprises lay in store when we studied diurnal (day-active) squirrels. Ten of 17 individuals belonging to six species had single peaks of active time in relatively bright light (3.6 to 200 lux), but four were most active in both bright light and darkness, and three preferred only darkness. Some animals shifted their preference to dimmer levels or darkness during inactivity: an eastern chipmunk, a least chipmunk, and an antelope ground squirrel had single marked preference peaks in darkness, four individuals had single less marked peaks there, while four others had only minor peaks in darkness.

In common with nocturnal rodents, diurnal squirrels generally sleep in dark quarters and visit these quarters periodically during the day. They are also well adapted for activity in darkness. Therefore, it seems likely that the unexpected sole preference of some individuals for switching the light down when they are active is merely the expression of an extreme shift of the balance point between competing tendencies: to prefer darkness when vision is unnecessary, and to prefer the light range in which vision



Far left, the slow loris was so fascinated with altering the lights that it did little else. The animal holds the record of 3764 alterations per day

Left, the only carnivore found to prefer darkness, a young adult genet

is best. Taken together, these results for 14 species of rodents and the mouse opossum present a strong case for a tendency in active small mammals of many species to prefer to be in darkness or extremely dim light when doing things that do not require vision.

Judith Ramos, Roy Havenhill, and I next investigated six species of small and medium-sized carnivores, all of which prey on rodents. Although only cats and dogs have had their retinæ studied extensively, most carnivores probably have duplex retinæ and can see well in both bright and dim light. Like the rodents, our carnivores quickly learned to control the lights. Similarly, they found it rewarding to visit both preferred and unpreferred levels and to alter the level frequently (as often as 378 times per day). But, somewhat to our surprise, they preferred only bright light, even though some of them are strictly nocturnal in the wild and are superbly adapted for seeing in dim light.

Bright light discrimination

The carnivores' preference for bright light may arise because many aspects of vision are best in bright light, for example colour vision and pattern and intensity discriminations. Presumably the preference of even the strictly nocturnal carnivores for bright light depends on the rewarding nature of the ability to make bright light discriminations each time a visit to bright light follows visits to dim levels, as opposed to making the discriminations continually in continuous bright light. The situation may be likened to enjoying the fragrance of a perfume when it is sampled from time to time, as opposed to accommodating to the fragrance when it is present continuously.

Charles Peters and I next studied four species of small nocturnal primates, including slow lorises, owl monkeys, and bushbabies. We were surprised to find that only four of the 10 individuals learned to control the light and express preferences although a few of the six failures were interested in altering the lights. These failures probably can be attributed to the fact that small primates, unlike rodents, do not thrive in solitary confinement. All six failures became finicky, went off their food, continually lost weight, and ended up sickly and lethargic. Of the successful animals—two greater bushbabies, a slow loris, and an owl monkey—the slow loris was our all-time champion performer: he became so "fascinated" with altering the lights that he did little else. He holds the record of 3764 alterations per day (roughly, once every eight seconds of activity). All the successful animals clearly

preferred dim light, ranging broadly from 0.001 to 0.10 lux (one-third starlight to full moon).

These primates resembled the nocturnal rodents in their strong avoidance of bright light, but differed from them in that they both avoided and were strongly inhibited by darkness. Of course, unlike rodents, primates do not burrow, do not retire to totally dark nests during the day, are not well adapted for activity in total darkness, and—crucially—they are active primarily in trees. As it would be decidedly non-adaptive for them to move around trees in total darkness, their avoidance of and inhibition by darkness are understandable.

Age difference response

Having completed our comparative survey, we followed-up interesting leads with in-depth studies of single species, testing and re-testing individuals at different ages. Our first in-depth study, of the cactus mouse, again produced surprises. Eight of nine individuals greatly preferred darkness or extremely dim light, while the ninth animal, which we studied at a single age, preferred intermediate dim light. The other eight animals strongly preferred intermediate dim light in the starlight range (0.0014 to 0.0025 lux), but not at all ages. In general the preference for dim light tended either to increase with age or not to appear until old age, when the major preference for darkness decreased.

This detailed study of the cactus mouse showed that light preferences can be labile over the short term (week to week), that they may be different for closely related individuals at the same age, that they may change with age, and that darkness is usually much preferred to dim light. But the results consistently gave the same answer for the optimum range for vision.

Having obtained these results we decided to review the earlier findings on the gopher and mouse opossums. It now seemed quite possible that in-depth studies of these species could indeed reveal the optimum light range for their vision. This followed because if we had studied only one or two cactus mice at a single age we would have found only the single marked peak in darkness, whereas with other individuals (or at other ages) we detected the dim light peak.

I am currently following on the carnivore study, and it seemed to me that the fact that the carnivores preferred bright light implied that properties of cone vision completely dominated their visual responses. Accordingly, I reasoned that if I were to test carnivores solely with light below the cone threshold, it might be possible to find an optimum level for their rod vision. Furthermore, by testing with higher and higher values of the brightest dim light, it might be possible to detect the cone threshold; at this point the rod peak would be expected to drop out, with an abrupt transfer to cone visual preferences and the appearance of a new peak at the brightest level. I am testing eight domestic cats from weaning to maturity. Although this study is still in progress, the trend of results is clear and, as usual, surprising. The cats prefer either the brightest level available or darkness, or both, regardless of whether the brightest level is in the rod or cone range. I can find no convincing evidence for a dim light peak. Moreover, the cats display large individual differences and changes in preferences with age. The extraordinary degree of light selectivity of some of the animals during inactivity is especially impressive.

Seven of the eight animals were most active in both bright light and darkness. The eighth animal (studied at a single age) preferred only bright light and was least active in the dark. In two animals tested just after weaning a preference for darkness did not appear until after 17 weeks of age, while in a third animal it disappeared after eight months. I tested three cats extensively for their comparative preferences: all three preferred brightness when

the possible top range was highest but switched to preferring darkness when the brightest light they could achieve was relatively dim. Only one animal gave any evidence of a cone threshold. Six of the eight cats were more selective during inactivity than during activity; inactive time of two animals peaked in both bright light and darkness, one animal very strongly preferred only darkness, and five preferred only bright light and avoided darkness.

From these results it appears that domestic cats also tend to prefer darkness when doing things for which they do not need to see well. This finding, although unexpected, is not unreasonable, for cats seem to be well adapted for activity in the dark. Although we tend to think of cats primarily as predators, they are preyed on by larger carnivores and some large birds. In fact, Judith Ramos and I showed that the activity of several other cat-sized carnivores during twilight is adaptive both for predation on smaller animals and for avoiding falling prey to larger ones.

In our first survey of six species of carnivores, only one of 12 animals had preferred darkness. Most of these other carnivores also seem to be well adapted for activity in the dark. If the discrepancy between this and the later cat study is not due to species differences, it may be that the other carnivores were simply too old to reveal a darkness preference. In this connection, the sole individual that did prefer darkness was a young adult genet.

The utility of the voluntary light-control technique for assaying the overall state of adaptation of an animal's visual system may be summed up as follows. The method appears to give optimum visual ranges for small nocturnal mammals with retinæ containing predominately rod visual cells. But even for these animals, there are complications. There appear to be competing tendencies (possibly age-dependent) between a preference for a mid-dim range of light, in which vision is best, and a preference for darkness, in which the animal is generally safest. Animals that are well adapted for activity in darkness sometimes express only the darkness preference in conditions where vision is unnecessary. For this reason it sometimes may be necessary to test and retest several individuals at different ages to determine the optimum range.

Things are more straightforward for nocturnal primates. Like the nocturnal rodents, these animals prefer mid-dim ranges and strongly avoid and are inhibited by darkness. The avoidance is understandable, since nocturnal primates live in trees where activity in extremely dim light or total darkness would be a very risky business.

For small and medium-sized mammals with appreciable numbers of (or predominantly) cone cells in the retina, vision simply appears to be better the brighter the light, at least up to a point. This probably arises because cone visual discriminations improve in brighter light. For these animals, a peak at a bright level below the brightest probably signifies only that deleterious effects on the visual system set in on lengthy exposure above the peak level, not necessarily that cone vision does not continue to improve above that level. Diurnal rodents and carnivores that are well adapted for activity in the dark may exhibit a competing tendency to prefer darkness, but this tendency only infrequently eclipses the preference for bright light.

Although the voluntary light-control test may not reveal optimum ranges for cone vision (if, indeed, such ranges exist), the test has other applications for animals with appreciable numbers of cones in their retina. One of these is the possibility of determining cone thresholds, particularly in carnivores. Another, that is applicable to all individuals that prefer darkness, is the determination of the dimmest detectable light. With undetectable dim light being one of the available levels there would be no preference for darkness, because the animals would be unable to distinguish between that level and darkness. □

Technology

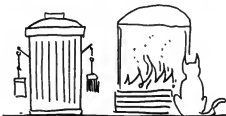
Eastbourne's rubbish could be the best in the world

Within three years the first plant in the world capable of producing fuel on a large scale from refuse could be operating in southern England and producing 40 000 tonnes of pelletised fuel a year. This is the prospect if proving trials of the process are successful at Eastbourne's pulveriser where equipment capable of turning out 7000 tonnes of fuel from East Sussex dustbins will shortly be installed (*New Scientist*, vol 74, p 465).

Sparse details of what is claimed to be a major breakthrough in the field of refuse derived fuel (RDF) were unveiled in the unlikely surrounding of Council offices in Lewes last week when a Swiss company Buhler Bros, along with Alts-hall Holdings Ltd, a UK marketing firm, announced their plans to test a technique developed by Buhlers in Zurich and which the firm now has agreement to incorporate in the seven-year-old municipal pulveriser at Eastbourne which the Swiss company also developed.

The exact nature of the process is still a secret but the technology involved rests heavily on techniques used for producing animal feedstuffs in pellet form. *New Scientist* understands that the Gloucester-based firm of Simon Barron has been involved in talks over the special machinery required.

On show last Wednesday were pellets produced in Switzerland and intended for both industrial and domestic use. The pellets are as large as a medium size Cuban cigar (though not so pleasing to the nostrils). Public analyst tests on the industrial version, which is green in colour, indicate that it has around half the calorific value of medium grade coal while the carbonised variety, intended as a smokeless fuel has apparently two-thirds the calorific value of a high grade domestic coal like Sunbrite.



Costs of the Eastbourne trials are being met by the two companies with the County Council supplying the raw material free plus the space at the pulveriser for the pilot plant.

Although the Council's involvement at present is very limited, it's clear the authority is keen to promote this sort of re-cycling exercise in a bid to solve its pressing problems over tipping space with existing land fill sites running out

over the next four years.

The Department of the Environment's own RDF research has been concentrating on ways of producing a pelletised fuel by modifying existing equipment—the Swiss approach apparently needs purpose-built machinery. The government's Warren Spring Laboratory has been looking at the production of fuel briquettes from refuse but in neither case have combustion trials been wholly satisfactory and there have been problems over storage.

Ironically, before East Sussex became involved with private enterprise it approached the DoE as a candidate for the current round of government sponsored re-cycling experiments which include RDF. In the event the two plum schemes went to South Yorkshire and Tyne and Wear but neither has got off the drawing board because of the current moratorium on all capital expenditure. □

Building safely on open cast mines

Displacement meters built into 23 otherwise ordinary houses in Corby New Town should help in the assessment of three methods of speeding up the stabilisation of infills for quarries and open-cast mines. In turn this should help provide the answers to the problem of how to build safely on the vast areas of land in Britain affected by open-cast mining.

Normally, open-cast mines are filled with loose earth once the seams are exhausted, but before any building can take place time has to be allowed for settlement. Depending on the depth of loose fill, which on average is about 50 m, this can be up to 25 years.

In Corby a closely monitored experiment is proceeding under which three 50 m square sites have been specially

treated to settle the earth in about six weeks. Conventional two-storey houses have been built on these, and on a fourth site left untreated to provide control data.

Instruments inside the houses, and others embedded in the soil, are giving an indication of how well the treatment has worked by measuring degrees of settlement to an accuracy of 1 mm. Preliminary results of the experiment, which started last autumn, are encouraging but it will be three years before final assessment can be made. After this the experiment's sponsors, engineers from Corby Development Corporation and the Building Research Establishment, hope the results will lead to extensive application of their ideas elsewhere. An estimated 6000 hectares of land is affected in Britain by open cast coal mining, much of it with good potential for house building.

The houses in Corby are on a recently filled ironstone open-cast site. The first method, dynamic consolidation, consists of dropping by crane weights of 10-15 tonnes on the earth from a height of about 20 m. It has been used in this country for several years but requires close technical control of the weights to allow for the correct degree of compression. The second is called earth surcharge and means that 10 m high piles of earth are heaped on top of the test site to compress it. Water inundation is the most novel method and consists of digging trenches and flooding the area so that water permeates through to the bedrock, settling the fill as it rains down.

At the time of the treatment on the Corby sites in late 1974, dynamic consolidation and surcharge were priced at about £30 000 per ha, a figure subject to many variables. The inundation method is less than half as expensive but it seems likely that it would be less effective. □

Natural rubber bounces back

The massive price increases of oil since 1973 have shifted the priorities of its use and one beneficiary has been natural, as opposed to oil-based synthetic rubber. Another is recycled rubber, a product which until the last year or two has been in the doldrums.

During the mid-1960s, it was generally accepted that natural rubber's share of world markets would fall to the 25 per cent—now pertaining in the US. At present the share is 33 per cent and forecasts in the industry are of natural rubber going on to take up to 40 per cent by the 1990s or earlier. Beyond that forecasts are less certain, but as petrochemicals are increasingly reserves for sophisticated and strategic purposes, it is easy to see that natural rubber, chemically modified, and with the aid of tree stimulants could take the lion's share of the largest market, car tyres.

But plantation acreage will be limited and there will be big price rises as soon as natural rubber really begins to improve its share of the market. Hence

the growing interest in recycling equipment exemplified by several new machines at Rubberex, the industry's annual equipment show held this year at Brighton. One is a new disintegrator and emulsifier to reduce viscous rubber to solution and to mix chemicals into it evenly in fast time during recycling. Another is a hydraulic guillotine specially designed for chopping up used rubber into small pieces for reclaiming. Both these and other bits of equipment can be adapted to recycle other wastes such as plastics or textiles.

But the significant thing about these new machines is that they are purpose-built for reclaiming rubber, in other words for an industry which until now has had to make do with other industries' cast-offs. At the simplest level it is not long since the Intermediate Technology Group published its "First steps in Village Mechanisation", which includes an account of how to recycle old tyres by cutting them into strips and nailing them to wheels of bullock carts. □

Technology

continued

Americans use a ring to picture a beating heart

A system that allows doctors to study the muscles inside a beating heart, being developed at the Donner medical facility of the Lawrence Berkeley Laboratory, makes use of tomography techniques to produce a moving display on a cathode ray tube. Images on the screen will show several different layers of muscle in the heart and also the blood flowing through it, without causing the patient much discomfort.

According to Thomas Buddinger, leader of the project, use of the system will allow early diagnosis of heart disease giving time for preventative measures to be applied. Stephen Derenzo, the physicist who helped design the system—called a positron ring camera—believes that its use will open the way for the medical fraternity to increase its knowledge of how vital organs, especially the heart and the brain, work.

The "camera" makes use of radiation patterns given by injected radio isotopes, in this case rubidium-82 which was specially selected because it concentrates in the heart and has a short lifetime (5 min). The positrons emitted by the isotope within the body pass between two lead slits and impinge on a bank of 280 sodium iodide crystals mounted in a ring around the patient's body. Impact of the positrons causes the crystals to scintillate, and light given off is converted to electronic signals, processed

by a computer and then used to drive the cathode ray tube.

The camera collects 9000 measurements through a 300 mm diameter area and following computer processing displays them in transverse three dimensional views, akin to showing a slice through the body. By "stacking" the slices, a full three-dimensional image of the organ is obtained. It differs from x-ray devices in that it provides information on metabolism and function and is not limited purely to anatomy. From the view point of safety, the team says that one injection of rubidium-82 is equivalent to a chest x-ray.

The same project team is near to perfecting methods of labelling amino acids for the study of the metabolic base of brain disorders such as schizophrenia. Further, the ring detector will provide a new means of studying some tumours and pancreas diseases.

The positron ring camera, which will be operational by October, and will start medical research in December, is a one-off designed for research. However, the team estimates it could build them in small quantities for about £400 000.

Meanwhile in Britain, workers at the British Nuclear Fuels Ltd. Seascale plant will in future be checked for radiation dosage by a "whole body monitor" designed by J&P Engineering, the small firm which introduced a radio isotope tomoscanner earlier this year (*New Scientist*, Vol 73, p 203).

The scanner combines eight large scintillation detectors—four above and four below the body—and two specialised detectors sensitive to particular types of radioactivity associated with nuclear fuel handling. The eight main scintillators can be precisely positioned by a combination of linear and angular movements to make specific measurements.

Expensive glider is as free as air

Imperial College aeronautical lecturer and glider pilot Frank Irving wishes to give away an advanced technology high performance sailplane, whose building cost was about £60 000. Small ads offering the aircraft free to a "suitable applicant" making proposals for further research have appeared in the US and Britain within the last few days. They mark the failure of an ambitious project for Britain to regain the world soaring lead and the end of one of the few re-

search aircraft to have been built in Britain in recent years.

The aircraft is the variable geometry Sigma, currently lying unused at the Cranfield Institute of Technology. With a wing span of 21 m and an aspect ratio of 36.2—the longest, thinnest, cantilever wings ever flown in Britain—Sigma was conceived in the mid-1960s as Britain's prime entry for the 1970 world Gliding Championships, although it was not until 1971 that the present aircraft flew. Since then it has spent only about 120 h in the air.

The flights have mainly been aimed at finding out why the performance predictions for Sigma were not borne out in flight. For with a very complex wing Sigma was expected to have a still-air gliding angle of about 1:50 and yet be able to circle tightly in the smallest areas of weak lift.

Sigma's most radical feature is, effectively, two sets of wings in one. Large full-span flaps mounted on swinging beams emerge rearwards and downwards from inside the toothpick-slim fixed part of the wing which has a chord of only 69 cm at the roof tapering to 41 cm at the tips. A special aerofoil section for Sigma was developed in Germany by Professor F. X. Wortmann, offered low-drag at lift co-efficients ranging from 0.1 to 0.8 for high-speed inter-thermal cruising flight.

But when the pilot encountered narrow thermals and wished to regain height he could extend the flaps, increasing the wing area by 35 per cent.

With a drastic reduction in wing loading from the cruising figure of 57 kg per sq m, stalling speed fell from well over 90 km/h an hour to a gentle 69 km/h enabling Sigma to be turned slowly and tightly in even the smallest areas of weak lift. From its maiden flight Sigma's performance was never up to scratch though according to Irving it has proved that the variable-wing works. □



Walking heavy

This Soviet walking excavator is in use at an open-pit mine near Krasnoyarsk in Western Siberia. Its bucket holds 100 cu.m and its dragline can scoop up 160 tons of rock and shift it some 200m. The excavator has four "shoes", which are lifted hydraulically 10 cm from the ground, when it makes its three-metre long steps. The dragline can take up to 20 such steps an hour. The Soviet mining engineers claim that the new machine can produce coal extremely cheaply because it gives access to seams 15 to 20 m thick. The Urals Heavy Engineering Works in Sverdlovsk is producing 10 more such excavators over the next few years and is also working on a larger model with 150 cu.m bucket. □

Germans go rocketing on the cheap

An unparalleled space vehicle is being prepared for first flight tests from the world's newest rocket testing ground in Zaïre in Africa. The rocket is being constructed by OTRAG (Orbital Transport and Rocket Company) in Neu-Isenburg near Frankfurt, West Germany. OTRAG is the only firm so far endeavouring to construct and sell rockets on a strictly commercial basis, without any government aid.

To attract customers the selling price for the rocket is about DM30 million, well below the \$18.21 million (DM43.51 million) required by NASA for a shuttle flight. It's also much less than the amount being quoted by the European Space Agency for the Ariane rocket (now under construction with the first test shot from Kourou in South America due in July 1979).

The OTRAG rocket does not incorporate any expensive space technology; instead it makes use of "every-day" industrial products in its assembly: steel pipes, instead of expensive rocket tanks; windscreen wiper motors for steering the fuel inlet; low cost fuel—diesel oil and nitric acid—instead of costly liquid oxygen and hydrogen. Expensive fuel pumps are not needed either—pressurised nitrogen does the job—and steering of the big booster is accomplished, not by venting the engines, which is very costly, but by throttling the outer engines of the big cluster of rocket motors planned for the first stage.

The company does have its technical problems, however. It intends to install a cluster of about 400 engines with three tons thrust each in the first stage of its three-stage vehicle—a feat unparalleled in space technology up to now. The whole booster would weigh roughly 1000 tons and stand 130 ft high. It would be capable of lifting a two-ton payload into geostationary orbit.

This is still a long way off, however. The first shot will have only four tanks and engines. The vehicle for that stands 32 ft in height, weighs 2.5 tons and develops a thrust of 12 tons. This vehicle has been tested using the facilities of

West Germany's biggest aerospace research establishment—Deutsche Forschungs- und Versuchs-Anstalt für Luft- und Raumfahrt—at Lampoldshausen near Heilbronn. Next year a bigger cluster is to be sent up, combining a 12-engine, first stage and a four-engine second stage. Stage separation and steering will then be tested for the first time.

OTRAG's director Lutz Kayser reckons the complete full size booster will be ready to go in 1981. He has rented a 40 000 sq mile launching area in Zaïre, because his first idea of launching from a ship proved to be impractical. Situated west of Lake Tanganyika in Zaïre's Shaba province neither the launching area nor the preparations for the first flight tests were affected by the recent military activities in the Katanga province.



Prototype for a commercial satellite launcher being tested at West Germany's largest aerospace research centre

Are 3-D movies a dream to come true?

Three dimensional cinema using holographic techniques will probably be perfected over the next few years, by the Soviet Union. A recent review of the five methods that have so far been proposed for stereoscopic cinema, by Charles Smith of the Kinematograph Sound and Television Society, left no doubt that the next break-through will come from the Soviet picture research association NIFKI.

Three-D films date back to the 1890s and William Friese-Greene. But early systems routed the left and right images to the respective eyes in clumsy fashion, separating them in time or space with periscopes, prisms or rotating shutters. Colour separation or anaglyph processes followed soon after, and have been used again recently for low budget exploitation films. Red and green images are viewed through red and green filters, one for each eye, but the system produces poor results and headaches for the audience after a few minutes.

Separation by cross-polarisation of the left and right images and viewing through cross-polarised spectacles is not the favoured process but was first demonstrated by Chrysler to 1½ million people at the 1939 New York World's Fair. Audiences were first freed of the need to be encumbered by spectacles in Moscow in 1941, when Ivanov projected 3-D films on a screen with a grid raster of 36 000 fine copper wires angled so that parallax prevented the left eye seeing the right image and vice versa.

Then, only a few months ago, NIFKI produced and demonstrated to the society's members in Moscow the first moving hologram projected in space. The Russian holographic camera uses a ruby pulse laser to produce the necessary coherent reference beam and illuminate the subject. The interference pattern created is recorded on 70mm film running at 1m/s and subsequent projection is with non-coherent light onto a fine grained interference screen which can be viewed from both sides.

So far only a total of four people at a time can view the spatial images produced by the system, and only a 30 second monochrome loop of film has been produced. But experiments are in hand to use red, green and blue lasers to produce a colour image on a screen of conventional cinema proportions. It thus now seems certain that holographic feature films will be showing in West End cinemas before the centenary of motion pictures in 1989.



Tasty, cheap straw may be good for cattle

Past attempts to produce animal feed from straw have failed because of processing cost and unpalatability. These obstacles now appear to have been overcome by a fermentation method developed in the United States at the Agricultural Experiment Station of Oregon State University. Youn W. Han and Arthur Anderson, microbiologists, have devised a process similar to that used in the East to make koji. It is inexpensive and uses simple equipment.

On a semi-solid straw substrate, fermentation is initiated by growing microorganisms. Straw is normally resistant to microbial degradation so it has to be pre-treated. First it is chopped

to less than ¼ in and then conveyed to a pressure cooker, before which it is sprayed with three parts of 0.5 normal sulphuric acid solution.

The straw is hydrolised in the pressure cooker, treated with ammonia or ammonium hydroxide. This produces a straw containing 20 per cent fermentable sugars and 2.3 per cent nitrogen, which is a suitable condition for yeast fermentation. Yeast is added and the fermentation is carried out aerobically for 35 hours.

The resultant feed is brown in colour and smells pleasantly of molasses. Crude protein content in the straw has increased from 3.1 to 7.10 per cent and digestibility from 32.7 to 46.6 per cent of the straw.

India: back to the villages

AT in the ivory tower

"To stand in an untouchable colony amidst termite attacked thatched roofs and 200 sq ft homes kept far tidier than warranted by the miserable condition is a sure way to restructure the priorities of institutions like the Indian Institute of Science and of education, science, and the technology in this country"

—A. K. N. Reddy, convenor, Astra cell, Indian Institute of Science

Joseph Hanlon
reports from India

There's a windmill on the roof at the Indian Institute of Science (IISc), Bangalore, and a citronella cooker on the campus of the Indian Institute of Technology (IIT), Bombay. Both work well and are physical evidence that a few technology academics and students are looking at rural development and appropriate technology (AT). In itself, this is a remarkable change. "Until four years ago, it was the fashion in all the prestigious institutions to proceed as if rural India did not exist," commented Professor Amulya Kumar N. Reddy, convenor of the IISc Astra cell (cell for the Application of Science and Technology to Rural Areas).

But if the past four years has seen a change on campus, it has yet to have an effect on the villages. "As yet, no technology has been transferred," admits Professor Anil Date, convenor of the AT unit at IIT, Bombay. At Astra, it is much the same (with one exception, a redesigned hand pump, of which more later). Perhaps four years is too short a time to expect results—but within two years Reddy's theoretical writings on AT lead to a one year assignment for him at the UN Environment Programme (UNEP) head office in Nairobi.

The potential for academic AT units is substantial. Even if technology is not the major need in rural areas, it is still true that certain development problems require new technology as part of their solution. Universities and technical institutes offer the only pool of potentially independent expertise with sophisticated laboratory and testing equipment. Already, voluntary field agencies have turned to academic scientists and engineers who have used their facilities—often surreptitiously—to solve simple technical problems. Even small-scale rural industrial technologies, however, are too complex to be sneaked through university labs and will require the resources of full-scale AT units.

The IISc and IIT, Bombay, AT units have much in common. Both were founded in 1974 and began with those projects beloved by alternative technologists everywhere—windmills and biogas. Both stress student projects, and both are interdepartmental, with faculty and students doing their work in their own departments. Finally, both conveners—Date and Reddy—are Imperial College, London, PhDs who a few years ago began to move away from traditional science. But in other ways they are different.

The IIT unit grew out of work by students and faculty in rural areas during the 1972-1973 drought. They felt that they should be able to do more than just distribute food and build small dams, and that some problems they had seen could be solved by appropriate technology. Date, who had returned from England in 1973, became convenor of the committee proposing the unit, and it was approved by IIT in 1974. Pramod V. Pathak, who had recently received his M. Tech from IIT, was appointed full time field coordinator, and links with voluntary field agencies that had been built during the drought were strengthened.

Two IIT projects are nearing completion, the rice dryer described in the first part of this series (p 388) and a citronella cooker. Citronella oil is used as a mosquito repellent and an industrial perfume component. Citronella grass is commonly grown around Bombay. Traditionally, the oil

is extracted by large processors; recently, however, a few rich farmers decided to extract the oil themselves and began using units which will process the grass from about 50 acres (the grass can be cut once a month). The IIT AT group has developed a simple citronella processor which would serve four acres and cost less than Rs 1000 (£67) to build—within the range of a cooperative of small farmers. The unit is a simple cylinder with water stored in the bottom and grass above. The water is boiled and the steam rising through the grass carries off the oil. The steam is then condensed and the oil floats on the water. Two batches of 50 kg of grass can be cooked per day. The IIT Conservation Programme has 1½ acres under citronella grass, and an experimental cooker has been in use on campus for a year.

The main focus of the IIT unit is undergraduate research programmes. Final year B. Tech students spend about six hours per week on a project, which can be with the AT unit; some 15 students participated this year, compared with seven in the previous two years together. Unfortunately, the students do not have enough time to complete a useful project, nor are they willing to pick up a project left unfinished by a previous student. For example, work was begun on a pedal operated heald making unit. Healds, or heddles, are the sets of small cords through which the warp is passed on a loom; every handloom weaver uses six per year. Not only could the unit be used in rural areas and supply weavers direct, but it could be made locally as it required nothing more sophisticated than a lathe. The AT unit even had unofficial help from a textile mill which showed the secret of how a particular knot could be tied. But the first student failed to finish it, then no-one picked the project up again until this year.

Little support at IIT

In practice, the AT unit appears to have won little support from either students or faculty. The IITs are modelled on MIT in the US. "IIT takes the cream of the students and they feel they should work on the most advanced aerospace projects; they don't want to go to the workshop, they want to use computers. So we get only the weakest students," Date admitted. One member of the AT unit added: "In 1973, we could get 100 students to a meeting. But that was a time when opposition to the national government found expression in rural development. Now rural development is



Dumping cow dung into a biogas plant. The tank on the left is the gas holder. Both IISc and IIT, Bombay, AT units are working on biogas technology

Astra builds a windmill—but who will buy it?

Although there seemed to be only a light breeze, the Astra windmill was pumping water 15m up from an IISc well. This sail type Savonius rotor generates enough power to pump with winds of only 10 km/h, which is important because most of India has relatively little wind.

The unit is designed and built by Dr S. P. Govindaraju (shown standing next to windmill, right). The sails are made of jute canvas coated with tar and the centre pole is a steel pipe. The only parts not available in a medium size town are the bearings.

Govindaraju has also built a simple pump from a scooter tyre. The pumping chamber is created by blocking the open centre of the tyre with two steel discs, one at each bead.

But how useful is the project? Except for Gujarat and certain coastal areas, there is no wind at all in India from October to February—which means that a windmill can only provide power for part of the year. And Govindaraju estimates that the windmill and pump will cost Rs 3500 (£230), similar to the cost of a biogas plant and well outside the purchasing power of any but the richest farmers. J.H.



Astra convenor
A. K. N. Reddy

Raising and lowering a disc changes the volume of the pumping chamber, and using conventional valves can pump water

Scooter tyre modified into a pump



a government slogan so it has lost its romance."

And the Institute itself has refused to sanction M. Tech or PhD projects in AT—precisely what is necessary to provide enough time and facilities to develop industrial machinery. For example, on the head machine, "the external examiners do not appreciate what we are trying to do. They ask, 'Why restrict yourself to a lathe for production' and they point out there are no stresses or strains to be calculated, no factors of safety to compute. But there are no calculations—it's all trial and error."

Nor is the Institute prepared to cope with the group's way of working. For example, field coordinator Pramod Pathak took buses to villages. It took the Institute 10 months to pay his expenses. "No one employed by the Institute had ever travelled by bus—they hired cars or travelled by first class train. And they wouldn't accept walking from one village to another because the start of one trip did not correspond to the end of another."

The unit may eventually gain more acceptability from the Institute. For the moment, however, Date continues non-AT research—he still has a substantial contract to study heat transfer in nuclear reactors. He admits that the unit has "limitations", but adds: "as a group that wants to maintain our stable employment, it is the most we can do."

At Astra, the atmosphere is completely different. Ten staff assist a number of faculty members and ten M. Eng. students on projects. A rural extension centre is now under construction. Research grants of more than Rs 850 000 (£57 000) have already been received from federal and state governments and the Tata Energy Research Institute.

The style in which Astra was created, so different from the IIT unit, may explain the difference in acceptability. Astra is the sole creation of A. K. N. Reddy, a man of considerable standing in traditional academia and not a new assistant professor like Date. At IISc since 1966, he is the author of the widely used *Modern Electrochemistry*. And the group setting up Astra contained four members of the Indian Academy of Sciences. "We had academic respectability," he says. "They could not lay a charge that we were doing AT only because we were failures at other technolo-

gies." Reddy then went on to create and become secretary to the Karnataka State Council for Science and Technology.

Astra's approach differs from IIT's in another way. "In the case of every problem we tackled we were able to demonstrate that it was as subtle and scientific as any of the muck we had done for 25 years," Reddy declares. And he accepts the need to show that rural problems are "publication-worthy and thesis-worthy".

Despite the money and organisational success, only one Astra project seems likely to reach villages in the near future—a redesigned hand pump. Of the 2686 hand pumps on wells in Karnataka, more than half do not work. They break simply because they are based on standard US and British designs for private pumps used perhaps a half an hour a day to pump water 30 feet. In India, an entire village uses one pump all day to lift water 100 feet. Reddy claims that Unicef, WHO, and UNEP all studied the problems unsuccessfully, spending £150 000, while Astra solved it for a mere £2000. Astra staff analysed why 38 pumps had failed, and found that most were due to simple failures of screws on the plunger rod or delivery pipe. The couplings were redesigned and have been adopted by Karnataka for all future hand pump installations, Reddy said.

One reason why so little technology has been transferred by either AT unit may be the way problems are chosen. Reddy admits that "if the task is left to the scientists alone, they usually end up choosing problems which are of concern only, or mainly, to those sections of society with which the scientists have the best contact—viz, the affluent urban cities." But precisely this seems to have happened; both AT units have had surprisingly little contact with rural areas. The IIT unit admits in its last annual report that the "majority of the problems undertaken are not taken from known needs felt in the rural areas. Thus capacities and performance criteria for which the equipment/processes are designed are imaginary, although reasonably close to what might be expected in a typical rural area." No-one from the unit has tried living in a village long enough to build up the confidence of the villagers. Date explains: "We want to be of some help, but we want to work in the city."

The results, he admits, is that the IIT people are seen as "strangers and weekend goers" and are not trusted. So the unit depends on contacts with people from voluntary field agencies already established in the villages.

At Astra, Reddy admits he had no real contact with rural areas until the cell was set up three years ago. In practice—except for short visits—there seems to have been little contact since. When pressed as to how the need for various projects was arrived at, Reddy can only speak vaguely of the need for development in general.

Astra is trying to crack the problem of rural contact in a big way—with a rural extension centre due to open later this year in the village of Ungra, 115 km from IISc at Bangalore. Astra is taking over a 55 acre "gone to seed government seed farm". Eventually, there will be workshops and accommodation for five permanent staff (including Reddy, who hopes to move there "soon") and 15 people on shorter visits—weekend to three months.

An attempt has been made to ensure that the academics live under the same conditions as the villagers. There will be no electricity or telephone (although Reddy talks of attempting to get a license for a radio link to Bangalore). The location was intentionally chosen too far away from Bangalore to permit day trips, so people will at least have to stay for one night. And Reddy warns that "if a civil engineer builds a low cost house, he must be prepared to live in it" at the centre—an important point, because many AT low cost building techniques have simply produced houses that even the homeless will not accept.

So far, not much contact has been made with the villagers in Ungra—"we have deliberately adopted an extremely low profile," Reddy said. It remains to be seen if a group of middle and upper class professionals, living in a compound adjacent to, but necessarily outside, the village can

ever come to understand its problems as well as voluntary workers who have lived for long periods of time in other villages. Won't the extension centre remain, as its name suggests, merely an extension of an elitist institute?

This raises the question of just what role such university AT units see for themselves. Reddy willingly points out that appropriate technology "is a necessary condition for development, but it is not a sufficient condition. It is also essential that the political structure and the socio-economic framework are both committed to development goals". And he warns that if "the selection is in favour of technologies which benefit currently underprivileged groups, the groups in power may not always take kindly to this new distribution of the cake." Clearly, AT is meaningless without parallel political action. Yet, the IIT unit speaks for both groups when it declares in its annual report: "trained technologists must carry out the task of producing technologies, and leave the job of organising people to social workers." The report also admits that the students disagree, which may explain low student interest there. It also may provide the answer to Date's comment to me: "Small technology leads to minicapitalism. I see this happening all the time. But I don't know the solution; I have not grasped the problem." Without a political framework, small technologies inevitably go to the people who can afford to buy them. This has already happened with biogas, tube wells, and small industrial technologies. Reddy cites as his goal not merely creating jobs, but also reducing income inequalities. It seems highly likely that if the AT units continue on their present course, they will simply produce new bits of technology which are either totally useless, or which are taken up by the rich for their personal use, or which are bought by a new set of minicapitalists to exploit the workers as before. □

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Forum

PERSPECTIVE

Which hand?

Christopher Macy

Making the human fit the machine is one of the great sins of technology, which modern humanism does not seem entirely to have conquered. And while untold sums may be spent on getting machines just right for the rightly pampered craftsmen of industry and skilled trades like aircraft pilots, the vast mass of the general public can safely be ignored. At least, that is what London Transport seems to think.

There have apparently been many complaints about the design of the automatic ticket barriers which are gradually spreading through London's tube system. The trouble is that the slot to receive the ticket for checking is on the right hand side. London Transport says that most people carry luggage in their left hand, which means they will prefer their ticket with their right hand, so that the machines are ergonomically correct for most travellers.

I myself have always doubted this. I usually carry my luggage in my right hand, unless it is raining and I am carrying an umbrella. This is partly because it seems to me that my right arm is stronger than my left. You might be right in suggesting that this is only because, as a result of my belief, I give it more exercise, but a more important reason is that being right handed I can handle a case and negotiate obstacles like fellow passengers' knees with more facility when I do it dextrously.

So I am always put to some trouble to get myself and my case and my ticket in good order through an automatic barrier. And since I am naturally bloody-minded my difficulty is increased by my fury at the foolishness of the design.

Doubts that I might, after all, be the odd man out, however, have always lingered. So to see whether I were actually in the minority (London Transport says I am) I conducted a little piece of unofficial observation at the entrance to the underground at Waterloo station. I positioned myself just inside the barriers, to one side, and counted for 10 minutes the number of people who used the barriers who had luggage in their right or left hands.

There appeared at first to be a large majority to support LT's case. Out of 62 people, men and women, 22 carried their luggage in their left hand and put the ticket in the slot with their right, while only eight carried their luggage in their right hand and their ticket in their left. (These were all carrying light items like handbags and document cases and put the ticket in with the hand in which they held the bag or case.) 20 people carried no luggage at all. All put the ticket in with their right hand.

It is, of course, extremely awkward to present your ticket across your body and insert it into a small opening on your wrong side. This no doubt accounts for the further group of nine people who carried their luggage in their left hand and put the ticket in with their right but who transferred their luggage back to their right hand after passing through the barrier. There may have been more who do this, but the distance from the barriers to the top of the escalators at this point is short and the subjects in my little informal pilot experiment were soon lost to my view. And three people actually did perform the uncomfortable task of cross presentation.

So the left hand majority looks pretty slim. Twenty people observably preferred to carry their luggage in their right hand compared with 22 who carried it in their left. The nine who arrived at the barrier with it in their left hand transferred to the right afterwards (in some instances quite heavy cases which had to be put down on the ground in the process, and then either lifted across the body or walked round) made me wonder how big a constraint on behaviour the hip-high tin dictators were. So I watched for a further 10 minutes the people who did not use the automatic barriers but walked past the ticket collector. There were 87 of these, compared with the 52 slaves to automation.

At Waterloo (at the time of writing—no doubt progress will remove this advantage soon) the ticket collector commands quite a respectable access, not the mean wicket gate in an otherwise impenetrable, not to say inhuman, fortress such as meets you at

Tottenham Court Road, or Siva-armed turnstile as at Warren Street. So there is no obstacle to luggage, and your ticket is inspected visually without your having to find a little slot, put it in and recover it.

Of those 87, 20 carried no luggage, 31 carried it in their left hand and 36 in their right. A small, and perhaps not statistically significant majority in favour of the right. However, even this figure is in some ways an artefact of the ticket-buying process, since the ticket machines deliver the ticket on the right hand side (facing you).

I was on the point of starting to observe whether there was any transfer of luggage at the ticket machines, and how users of the machines compared with those who bought them at the booking office when the station manager approached me and very politely pointed out that I needed his permission to carry out surveys on his station, and gently asked me to clear off.

I suppose that compared with the huge queues at booking offices when the ticket machines are out of action, as they often seem to be these days (especially at Euston, where one arrives back late on Sundays after a prolonged journey because of engineering works on the main line, having returned from York by way of Manchester, or somewhere, and is faced with a seemingly endless human snake and a row of dumb machines which stand and wait but certainly do not serve) the question of which hand one carries one's luggage in may seem trivial. But how trivial depends on the size of the case. And in any case, surely not more trivial than the effort needed on London Transport's part to put matters right—that is, left—on its next batch of barriers. After all, they can't be in mass production yet. Or can they?

ENVIRONMENT

Grass roots

John Burton

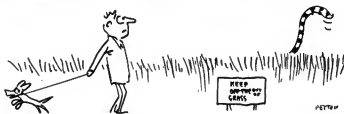
I am frequently asked "what prevents wildlife colonising urban environments?". Most people expect pollution to be a major factor, but except in the case of water pollution affecting aquatic life, I doubt that pollution is generally significant. My belief is that disturbance is the main factor controlling wildlife in cities. And it is at this time of the year that we can observe one form of disturbance in *extremis*.

Tidy-minded guardians of our city parks have been eagerly waiting for the grasslands of the parks and commons to dry out, so that they can send the vanguard of their army of mowers across them and reduce the lush herbage to a few millimetres in height. Rollers will smooth the ground to enable the cutters to reduce the height of the grass even more. Soon the only irregularity to break the monotony of the yellowing acres in the June sun will be the heaps of canine excrement.

In the streets, the highways departments have been busy in many city boroughs reducing trees, particularly lime trees, to palatial stumps from which the leaves will sprout several weeks after a normal unamputated tree is covered with greenery.

The third form of mutilation has been completed by now—all the dead timber has been removed from the parks, leaving the trees healthily pruned.

The result of this mania for tidiness is a loss of wildlife. In the parts of the parks and commons not required for sports fields were mown but once a year, perhaps we would see the reappearance of the rich meadowland and open downland flora which has disappeared from so much of rural England. This would also provide habitat for a wealth of wildlife—small mammals, amphibians, reptiles, butterflies and birds. Similarly



Forum

continued

unmutilated trees would not only be aesthetically more pleasing, but provide food and shelter for wildlife. Leaving dead timber also provides habitat for insects and birds alike.

Why not then? Dead timber it could be argued is a risk—but then so are cars in parks; I suspect there are more people injured in parks every year by cars than falling timber. No, I believe the real reason is that all the local government departments concerned are trying to show that they are doing their job. After all the rate-payer will find it very difficult to assess value for money if the local parks department were to encourage natural vegetation to take over—but it is all too easy to present facts and figures on the number of acres mown, the number of trees pruned and so forth.

Does the British public really want acres of mono-cultured grass? □

WESTMINSTER SCENE

Rolls to go it alone

Tam Dalyell MP



MPs who represent areas of aero-engine manufacturing, or with substantial interests in the manufacture of parts of aero-engines, have been following the talks between Rolls Royce and Pratt and Whitney, the US engine manufacturing giant on the joint production of a new jet engine, the JT 10 D. These talks have now come to nothing, the big aircraft companies in America have apparently said that the JT 10 D

would not have sufficient thrust (up to 24 000 lb) to power the new generation of airliners now being designed.

At first sight, this is bad news. Work on the JT 10 D would have provided thousands of jobs at Rolls Royce, and the beneficial effects would have had a multiplier effect around British industry. But Rolls now tells us that it is filling the gap, by scaling down its RB 211 engine and offering it as power plant for the new airliners. A version of the RB 211 not only powers TriStar, but is now flying on British Airways jumbo jets with 50 000 lb of thrust. By "clipping" this engine, the RB 211 could give the 32 000 lb of thrust—the sort of power the aircraft manufacturers are now demanding.

MPs understand that though Rolls and Pratt and Whitney have been discussing the JT 10 D project together for more than two years, and had actually got to the stage of drawing up heads of agreement for a contract, the parting has been on friendly terms and without rancour.

It is true that, in the absence of an American partner, Rolls will find it more difficult to sell its clipped RB 211 in the American market, where it will be up against General Electric, the third big engine manufacturer in the Western world, which is scaling down its big fan engine, the CF 6. On the other hand although the market will be harder, Rolls working on its own will have certain advantages. In particular, the development cost will be a fraction of that of a new project; and the airlines are more likely to buy it because they know that the inevitable technical bugs will have already been ironed out of the RB 211 engine.

Trevor Skeet, Bedford, has been asking the Energy Department what secondary upgrading capacity will be necessary to produce the yield patterns needed to meet national demand for light distillates, a question of great importance to oil refining communities.

Dr Dickson Mabon, Minister of State said that at the end of 1976, the gross throughput capacity of catalytic, thermal, and hydrocracking plants at British refineries was about 13 million tons per year. At a normally high rate of use that level of



capacity would correspond to the use as feedstock, or as a source of feedstock, of roughly 40 per cent of the residual fuel oil produced by crude distillation in 1976.

New cracking units are under construction at the Shell Haven, Lindsey and Mobil Coryton refineries, and Texaco and Gulf have also announced a possible further project at Milford Haven. Those schemes would provide additional capacity of 7 million tons a year. The government says that it is not possible to provide a simple estimate of the amount of new upgrading capacity needed to balance the national demand position.

Different types of cracking plants produce different yields of light distillate at a given throughput level, and there are also important product quality considerations. Changes in the type of crude oil refined and in other secondary refining plant will also affect the position. The schemes now in hand will make a valuable contribution but further projects will be needed to eliminate the United Kingdom's net deficit of light distillates and cater for future growth in demand.

That demand will depend partly on costs, which, in the North Sea, are now varying widely from one oil-field to another; the overall range for the 14 currently commercial fields is now estimated to be \$3 to \$9 a barrel at 1976 prices. (This compares with an estimate previously of \$2 to \$3 per barrel.)

Jim Craigie, Maryhill, asked the Secretary of State for Scotland what use was being made of the Building Research Station by the Scottish Development Department, the Scottish Special Housing Association, and new towns and local housing authorities in Scotland to find new methods of overcoming the problems of dampness and condensation in multi-storey blocks and other dwellings.

Hugh Brown, Provan, Under Secretary of State for Housing at the Scottish Office, replied that wide use was made of the specialist advisory service of the Building Research Establishment Scottish Laboratory on problems of dampness and condensation. In 1971, a study by the Scottish Development Department and the BRE resulted in the issue of a memorandum, *Condensation: Diagnosis, Treatment, and Remedial Measures on Existing Houses*, to all housing authorities in Scotland. BRE has recently cooperated with the National Building Agency in the production of reports for Glasgow District Council on condensation problems of flats, which ought to be looked at by any tenant or house-owner bothered by the problem, and particularly by local authority officials.

The Secretary of State for Social Services, David Ennals, has announced that he is going to fund a research project into the support needed by families caring for elderly relatives. Many MPs would say that it is not research which is needed but money and resources to provide facilities so that elderly relatives can be taken in on a temporary basis, while the rest of the family get some care or respite.

Andrew Bennett, Stockport, asked what evidence the department had that so-called "granny-bashing" was a growing problem, and if the Secretary of State would set up an investigation to establish the relationship between this problem and the need to care for elderly relatives.

Ennals told the House that domiciliary staff were well aware of the need to be on the alert for any possible signs of ill-treatment; but he had no evidence that the problem was increasing. The need for geriatric beds was essential and also more provision in the community for old people's facilities. But he contended that the purpose of the research was also important.

There was a range of specific factors such as incontinence or sleep disturbance, which provoked crises for families looking after elderly people. The research would investigate relief measures on such matters. □

ECONOMICS

Eurodollars

Anthony Renton

One of the largest and fastest-growing businesses in the world is the production of "eurodollars" and other "eurocurrencies" by "eurobanks". A eurodollar is simply a dollar deposit in a bank outside the USA; a euromark is a mark-denominated deposit in a bank outside Germany, etc. Any deposit denominated in a currency other than that of the country in which the bank is located is a eurocurrency.

Between 1961 and today bank deposits denominated in overseas currencies have grown at a staggering rate—from \$1000 million to about \$400 000 million. About three-quarters of these are dollar deposits and the rest are mainly marks and Swiss francs. Most of the eurocurrency deposits are issued in London; there are about 350 eurobanks in London now, many of them branches of the leading US banks.

One reason for the growth of eurodollars goes back to the 1950s. In those days the Russians, who needed dollars because it was the most useful currency for financing their international trade, were reluctant to hold their dollars in New York for fear of expropriation and consequently held them in London instead. They judged the political risk was lower in London.

Since then, however, other factors have been predominant. First, in 1965 and 1968 the American authorities imposed a programme of "voluntary" restraint on outflows of capital from the USA. This stimulated an increased demand for dollars overseas and bid up the interest rate offered on eurodollar deposits, which at times has been as much as 3 percentage points higher than comparable US domestic interest rates. The US authorities also imposed ceilings on the interest rates payable on domestic dollar deposits. The result was a large transfer of non-resident funds from New York to the eurobanks.

The spread of US multinational companies and a substantial increase in US foreign investment ensured that the demand for eurodollars did not slacken. Also, since all eurocurrencies are linked by interest arbitrage—funds received from selling a deposit in one currency can be used to buy a loan in any other currency—any rise in the interest rate on eurodollars tends to be accompanied by rising interest rates on all eurocurrencies and a consequent increase in the volume of external deposits denominated in these currencies.

One way in which eurodollars are created is by an investor shifting funds out of the US. If an Arab sheikh wishes to hold his dollars outside America, he simply writes a cheque on his New York bank account and pays it into his London bank. The London bank will probably deposit this cheque in its New York branch. Total deposits in the US are unaffected, but dollar deposits in London have increased. The volume of dollar deposits in the world has therefore risen.

Secondly, however, banks' lending activities also create eurocurrencies. If a firm borrows dollars from a London bank, its loan will take the form of a dollar deposit with the bank against which the firm can write cheques. Money—a bank deposit—is created by a stroke of the bookkeeper's pen.

This second process is quite general. Domestic banks too expand loans by creating deposits. But there is a limit. This is not just a matter of prudence, but of law. The Bank of England both regulates the liquid or reserve assets of the domestic banks and lays down the volume of these that they must hold as reserves against their deposit liabilities. The rule is that reserves must be at least 12½ per cent of deposits, so that in principle the domestic banking system can expand loans and deposits by only £8 for every additional £1 deposit.

In the eurobanking business, however, there are no reserve requirements, no officially defined reserve base, and no control over reserves. The eurobanks are outside US jurisdiction and they are not controlled by the British authorities since their deposits are denominated in foreign currencies. Much of the world's borrowing and lending activity has been shifted from US jurisdiction to an offshore unregulated market. And, fundamentally, the desire to avoid regulation is at the core.

There is an obvious danger that the pyramid might collapse.

\$1 million transferred from New York to London will lead to a much larger increase in eurodollars since the London bank will on-lend the \$1 million to a third bank, which will lend them to a customer who buys goods from a firm which re-deposits the dollars in a fourth bank, etc. The only limit on the process is set by the banks themselves, who both have to earn interest on their deposits by re-lending and retain sufficient cash to meet any likely withdrawals. In the UK 12½ per cent cash is thought sufficient to meet withdrawals. In the eurocurrency business the reserve ratio is much less than this. The danger is that if a bank is imprudent or miscalculates, so that it cannot repay its deposits, there could be a run on the whole eurobanking system.

Access to the euromarket also enables people to circumvent national monetary controls, thus reducing the effectiveness of domestic monetary policy.

However, undoubtedly, any attempt to regulate eurobanking would simply cause the business to shift to Panama, Bahamas or some other place which promised no regulation. The only way to curb the business would be for all governments to limit access to the market, ie tighten controls on the international movement of capital. But this would have well-known harmful effects on the development of world trade and economic development generally. So the eurobanking business continues to be unregulated and continues to flourish. □

WASHINGTON VIEW

Transient problems

Dan Greenberg



Going through my files recently, I was pleased to note the evaporation—not the solution—of many issues and problems that at one time or another were of intense public concern. From these findings I do not conclude that public-minded citizens should adopt a policy of leave it alone and it will go away; on the other hand, the thought is not to be discarded altogether.

Consider, for example, automation, which, of course, is still with us. Once the object of angry debate, scholarly examination, national conferences, and exhaustive articles, it has mercifully decamped from the public stage. I can't imagine that it still isn't the problem that it was once thought to be, but there you have it—gone and forgotten.

Then there's German reunification, the achievement or denial of which—depending on one's point of view—was long the central issue for avoiding World War III. Also gone, though the situation that once made it a matter of dire interest still persists. Perhaps weariness set in on the conference circuit or publishers found that the topic no longer sold. Whatever the case, German reunification has not been heard of for some years.

For decades, the national debt always got a good going over in our presidential elections, but the last time around not a word was uttered on the subject, though the debt now amounts to some extraordinary figure. Its disappearance from public controversy is surely mourned by political speech writers, for the debt—though no-one is certain what it really means—lends itself to a variety of dramatic formulations. Thus, though one could easily go through life without personally encountering the national debt, it was disconcerting to be told that because of the incompetence and greed of certain officials, one was in hock for many thousands of dollars. In some sort of ethereal book-keeping system, this was probably so, and the assertion at election time did get a lot of folks seriously aroused. The national debt, however, is quite remote from our everyday lives. Perhaps pollsters advised the candidates that the voters are tired of it or don't understand it. At any rate we haven't had a word on it for several years.

Same can be said about the domino theory, the centrepiece

Forum

continued

of American foreign policy for 25 years. Presidents, secretaries of state, leader writers, and well-informed citizens routinely invoked the domino theory whenever doubt was raised about the advisability of rushing troops to some unruly corner of the world. Skeptics were warned that the theory could be scoffed at only at the peril of western democracy.

An entire generation came of age with the understanding that nations were like closely linked up little wooden rectangles and that if one toppled, lots of others would go over, too. The theory can, of course, be attached to Europe's World War II experience, and, therefore, may have validity in some circumstances. The aftermath of the Vietnam débâcle, at least so far, suggests otherwise. In any case, though neither proven nor disproven, this once mighty concept has slipped from public debate, without any apparent loss to our understanding of foreign affairs.

Also missing and unaccounted for is the generation gap. Which, though always with us, soared to prominence in the 1960s, and then disappeared. It kept a lot of writers and salaried thinkers quite busy for a while. They provided us with many examples of young folks and old folks not getting on too well. They're not getting on any better these days, but as a problem that merits concern, the generation gap is passé. Not a word about it in the public prints for quite some time.

The files reveal a lot of bygone concern about the "two cultures". Lots of conferences and a vast literature on the menace of scientific illiteracy. Perhaps it's been reduced a bit—after all, we do have a President who was trained in nuclear engineering and a Secretary of Defense who is a full-fledged physicist. But apart from them, the cast of characters in high political office here and elsewhere remains as dense as ever on things scientific. The two cultures crisis, however, has also dropped from sight.

Also missing without trace is the so-called American challenge and its derivative, the technology gap. Maybe it's because the western economies are sagging so badly that they've all fallen into the gap, thus rendering it unnoticeable. The "Gap", however, was once a big issue; it evoked learned papers from holders of elevated offices, and an international conference or two was convened on the subject. But, as with many of the aforementioned problems and issues, it's been relegated to the archives without ever having been solved.

As suggested earlier, the quiet disappearance of these matters should not inspire indifference to serious public concerns. However, what it should inspire is consideration as to whether our "problems" are real problems or whether they are products of a thriving academic-journalistic-government problem industry.

Incidentally, whatever happened to the yellow peril, Egypt's inability to run the Suez Canal, the post-Vietnam "bloodbath", the teacher shortage, and the "information explosion"? □

PIG-IGNORANT Telling the tale

Peter Laurie



Last time I mandered on about the few basic elements of story-telling—which was quite interesting, for the porcine at any rate—and suggested further problems, like what is the point of telling stories at all?

I rounded off the last piece by saying that "without a framework of fantasy life would make no sense." It seemed quite a neat way of stopping, which is always tricky. But when one thinks

more, perhaps that remark wasn't so vacuous as it might appear. If we are to have any kind of social life, any kind of co-operation, it is necessary that we share not only a language, but



also a wide general area of ideas and interpretations of things that can be described in that language. In crude terms, if one says "rapist" or "murderer" it is quite important that the other ascribes not just the dictionary definition to those words, but also real vivid meanings, because the importance of the words lies in their emotional implications, what the people who earn those names do to others' lives.

Now, happily, very few people will have any first hand experience of either of them. If there were no stories and no story-tellers, we would each have either to wait till we met a rapist or a murderer till we understood what the words meant, or do without.

In a jollier vein: each one of us has one or perhaps two real loves in our lifetime. If it were not for stories of other people's loves, one would be stuck with the idiosyncratic and possibly painful history of these two with which to flesh out the behaviour of other people. Because often one can only understand other people's behaviour by fantasising about them, and the main material for fantasy is fiction. Or, again, a large preoccupation of the twentieth century is war and preparing for war. Perhaps a majority of the British are too young to remember what it was like—and even if they could remember, they would only know a small part. To persuade people of the nature of war and the need to be prepared against it, society must rely on the story-teller. And in a way his efforts are much better than experience because he can combine the experiences of many people, of the general and the private.

Of course there's a snag: the bastard may not tell the truth. He may lie—more often through incompetence than malice. But what is the truth about an experience which no-one ever had? For that is the definition of fiction. There can't really be a truth about that. There can only be a trend of believability, which is more a function of the state of ideas at large in the audience than of what "actually happened". As Goebbels so unkindly said, "Truth is what people believe." And every story-teller knows the moment when you say to yourself, hold on, that won't do, they'll never swallow that. Even though it did happen. But, even so, the untruth serves to give people a common framework of "experiences". If you want to know a person, as good a check as any is to look at their bookshelf, to find out at what pool, of the many pools of ideas, their mind drinks.

An obvious way to control society is to control its fantasies, because that is to control the way it makes sense of what happens to it. Yet it may be that the obvious way to apply censorship is not the best. If you forbid certain experiences—as we do even though one might not think so—like child rape, the very vacuum tends to interest, to provoke fantastical ideas. There is nothing better for a sensible approach to things than boredom.

The great artist—who may not be the name you read afterwards in the history books—sets the hares running, and the hacks serve their turn by chasing them into the ground, by making them so dull that there is no longer any question about them. It all works out beautifully. Still, if I were the Chief Censor, with complete power over works of art, I think there's only one I would ban: and that is Laocis' *Les Liaisons Dangereuses*. It's about a middle aged man and woman, both with great sexual experience, setting out to besot two teenagers. Perhaps I have an evil streak in me but it seems to me these are ideas best not noised about. It would be interesting to know what other works readers would expunge if they could. Any offers? □

Review

Darwin and his flowers: the key to natural selection

by Mea Allan
Faber, £6.95

It takes courage to write another book about Darwin. My first impression of this beautifully illustrated volume was that it fell into the category known pejoratively as a "coffee-table book"—full of light entertainment but making no demand on the intellect. I could not have been more wrong. People are incurably anthropocentric; it is therefore not surprising that the popular conception of Darwin's work is based on his studies of animal evolution, especially the evolution of the higher vertebrates and its relevance to the descent of man. Darwin's work on plants is less familiar, even to professional botanists. His research on plant hybridisation was eclipsed by the discoveries of Mendel and his work on plant behaviour went out of fashion when plant physiologists got on to the bandwagon of reductionism and neglected whole-plant physiology because it was too difficult.

Mea Allan has restored the true perspective of Darwin's scientific career by writing a book about his researches on plants. The facts are drawn largely from the seven books on botanical themes published after the *Origin of Species*; but the author has done what (so far as I know) no-one has done before: she has set out the material in a way which emphasises how these researches influenced Darwin's concepts about evolution.

A book with this theme might well have been a monograph on the history of biology, suitable only for historians of science. But Mea Allan has done something much more difficult—and more elegant—than that. She has blended accurate and lucid accounts of Darwin's work on plant hybridisation and behaviour with a charming account of his life. Her main source is the three-volume *Life and Letters*, long out of print (and not light reading anyway). This she has supplemented with material from the large collection in Cambridge to produce a story which contains some new material and some surprises even for scholars who

already know a lot about Darwin.

The book is written in an easy style, slightly coloured with journalism which academics may find a bit irritating—but then academics are so accustomed to stuffy writing—and it can be recommended without hesitation to the so-called "lay" reader. There are some superb colour plates, pictures of people and scenes connected with Darwin's life, and some charming drawings and photographs from Darwin's manuscript notebooks. There is a good index and an adequate bibliography. *Eric Ashby*

The last chance

Nuclear proliferation and

arms control

by William Epstein

New York Free Press, \$16.50

Believers in arms control measures are mainly those who see them merely as a way of furthering Soviet-American détente, those who look to them as a way of managing (rather than stopping) the Soviet-American arms race, and those diplomats, politicians and international (that is UN) civil servants actually engaged in the negotiations of arms control treaties. Non-believers are mainly those who appreciate the urgent need for nuclear disarmament but who clearly see that developments in military technology occur so rapidly that arms control treaties are normally rendered obsolete even while they are being negotiated.

Scientists will find *The Last Chance* an interesting book not because it says new things about arms control but because William Epstein was, when director of the Disarmament Division of the UN Secretariat, an ardent believer who, as soon as he stopped participating in the arms control game, became just as ardent a non-believer. *The Last Chance* contains an analysis of the Non-Proliferation Treaty (NPT)—including safeguards, nuclear assistance to the third world and the peaceful nuclear explosive issue—and a description of the abortive attempt to strengthen the Treaty at the 1975 NPT review conference.

Epstein then gives his own prescription for disarmament—a 12 point programme of measures which he regards as

the minimum necessary to avoid nuclear catastrophe. The author has few illusions about his list being adopted "as an agenda for negotiation in the immediate future". Military, industrial, scientific or bureaucratic groups in the major powers would, he rightly suspects, successfully oppose this. *Frank Barnaby*

Food and agriculture

A Scientific American Book

W. H. Freeman, £7.20,

£3.60 ppb

The book version of the October 1976 "special issue" is one of the most comprehensive articulations of the present "traditionalist" approach to the world food problem.

The series of articles, while appearing to be "objective" and biologically precise, is so divorced from the real world that most of it makes static and turgid reading. One article by Robert Loomis hints that ecology and economics combine to determine what crops are grown where. Otherwise, each of the articles talk as if the problem were a technical one of pushing back the biological limits of production.

That is, all except for one article which stands out above the rest. The opening essay by Sterling Wooman links all the other articles together within a very succinct and clear description of present economic attitudes to development as expressed by the more progressive (or "softer") traditionalists.

The problem, as just about everybody agrees, is why are there millions of people hungry in the world when there are the resources and ability to support many times the present world population. The *Scientific American* authors still refer to Malthus, implying that the problem is a natural one rather than a political one. But as Wooman recognises, it is the political pressures now emerging that are going to force something to be done. Unless government leaders take steps to develop their rural areas, "they may well be faced with a continuing unrest and violence and even revolution".

To avoid this, Wooman offers three "traditional" solutions: a radical redistribution of available food from rich countries to poor; the despatch

of selective help to those countries they give a reasonable chance of survival; or, for the optimists, the gradual improvement of food supplies as agricultural productivity is improved. Wooman goes for the "selective help" philosophy, with the proviso that "only if it is engendered by radically new public policies both in rich nations and in the poor nations themselves". Apparently, "all-out effort to increase food production in the poor, food-deficit countries may be the best means of raising incomes and accumulating capital for economic development".

This sounds quite progressive, and he becomes even more so when dismissing the "non-solutions" to the problem. "Larger harvests in the surplus production countries... are not a solution... and are counterproductive.... Western-style large-scale mechanised farming is also not a solution.... The advent of synthetic foods, single cell proteins and so on will not be a solution."

So what is their solution? Apparently, "well organised campaigns are needed to force the pace of agricultural development, with the key elements being inputs of biological technology and of capital for building the infrastructure". The inputs of biological technology are more fertilisers and high yielding varieties of grain and sorghum etc., and the capital will be supplied by the World Bank, the Inter American Development Bank and the African Development Bank. All it needs is the governments to have the "will". If it sounds like more of the green revolution, that is exactly what it is.

So what's wrong with that? Well, it has been shown by various UN studies that the green revolution has not increased yields when considering large areas of land. All it has done is concentrate production in intensive areas to the detriment of more marginal areas. More fundamentally, it has undermined and totally transformed the relations of production such that the previously subsistent farmers have become starving wage labourers, or part of the urban unemployed.

How is it that such seemingly "responsible" solutions wreak such havoc? Is it any accident? All the proposals are "aimed at generating the main

Review

continued

ingredient for rural development; increased income for large numbers of families. . . . The improvement of agricultural productivity is the best route to economic advancement for agrarian developing countries". Now we see why the havoc is not accidental, but fundamental to the approach. First, agricultural productivity seeks to maximise productivity of labour (not necessarily of land), which is obviously just what most developing countries don't need. They do not need structural unemployment.

More importantly, however, the mechanism still supposes that the problems (and solutions) lie in the market. Increase the income of the disadvantaged, so that they can start buying and all is well. To put it mildly, this is misplaced. The problems do not lie in talking about individual commodities, improving terms of trade, markets, supply and demand etc. They are to do with predicting long-term trends, with relations of power, with class, with the ownership of capital and with the role of the state. Most people don't want to talk about these, certainly not *Scientific American*.

Charlie Clutterbuck

Univers de la psychologie

Paris: Editions Lidis,

Set of seven volumes

1963 francs

This is the first of seven volumes, Gargantuan in bulk and scope, recalling the spirit of the French encyclopaedists of the 18th century, Diderot and d'Alembert and their friends. The editors have made a Napoleonic bid to conquer the "universe" (not the mere "world") of psychology.

Volume I deals with: (i) pre-scientific images of psychic life, in archaic societies, in India, China, Greece, Rome, Egypt and the Middle East, in the Christian Middle Ages and the Renaissance, and in the Classic and Romantic periods from the 17th to the 19th centuries; (ii) scientific developments since the 19th century; and (iii) methods and domains. Succeeding volumes will cover the entire range of normal and abnormal phenomena, play and leisure, art and religion, applied psychology, and para- and esoteric psychology. The seventh volume—a dictionary of terms—is given to subscribers gratis.

No doubt the Renault worker, like his wine-growing fellow countryman in the Languedoc, is eagerly awaiting this lavishly illustrated encyclopaedia. The most fetching picture taken by Dr Hamon of the Collège de France, depicts a rabbit, after an injection of parachlorophenylamine, lustfully mounting a cat, who seems somewhat taken aback by the unprecedented encounter. Most of the illustrations entertain rather than instruct. For unlike (say) physiology and anatomy, psychology is not pictorial. You can't illustrate a thought, a wish, a memory, anxiety, hate or meaning, as you can, for example, the structure of the eye or the dermatomes. I am inclined to doubt whether Uly Geller's spectacular contributions to the science of spoon-bending justify a half-page photograph of him in the act.

The articles in the first volume vary greatly in interest and quality. No-one with any sense of history can fail to be fascinated by the scholarly and clear accounts of ideas of man and mind in antiquity. And many will have their appetites whetted, even if they do not understand much, by the excellent sketches of physiological, pharmacological, cybernetic, mathematical and computer psychology. Ironically, the most pedestrian and uncritical articles are those dealing with bread-and-butter topics, such as intelligence, aptitude and personality testing.

The editorial decisions as to what to include or exclude must have rested heavily on popular appeal. The outcome reflects a commendable breadth of Gallic vision and innovative zeal, coupled, however, with a rigid adherence to certain outmoded ideas and practices, which some French appear to swallow hook, line and sinker.

It is a pity that Yves Pélicier, who writes illuminating introductions to the various sections, did not provide an index. This would have greatly aided the reader in tracing names and topics which repeatedly crop up.

An English version, retaining the historical, the cultural and the genuine parts, while omitting the dubious and highly questionable, might be worth while. Unfortunately, members of the public are as glib as psychologists, and they will greet with open arms

any mumbo-jumbo so long as it masquerades as science.

John Cohen

Galaxy formation

by John Gribbin

Macmillan, £5.95, £2.95 pbp

The Universe contains a fascinating variety of galaxy forms ranging from smooth ellipticals through tightly wound spiral to bizarre irregulars. Their masses lie on the range 10^6 to 10^{11} times the mass of the Sun. Despite the differences in the morphological structures of galaxies, there seem to be some underlying patterns in their properties. For example, the ellipticals are comprised of old stars formed early in the history of the Universe, while the spirals contain a base of such stars plus an imbedded population of luminous young stars which give a characteristic spiral imprint. One is then faced with the question of what formation processes were involved to give such a range of galaxy morphologies. Clearly what we see now is a consequence of events in the early Universe; some irregularities must have existed at that time which have since grown to produce the current crop of galaxies rather than, say, a uniform scattering of planets or of boulders through intergalactic space. Many attempts have been made to explain the basic properties of galaxies such as their mass, diameter and angular momentum.

One possible approach is to say that galaxies formed from the turbulent eddies associated with the early phases of the expansion of the Universe while a contrasting approach postulates the existence of cores or singularities (possibly, but not necessarily, black holes) which accrete material and may subsequently produce the variety of explosive phenomena (radio and Seyfert galaxies and quasars) associated with some galaxies. In this book, John Gribbin discusses some of the ways in which these fundamental problems have been tackled, and provides a very readable introduction to a subject which is at the forefront of much current observational research over the entire electromagnetic spectrum as astronomers attempt to obtain even the most basic data on the origins of the Universe. Rodney Davies

Transport without wheels

edited by E. R. Laithwaite

Paul Elek, £15

Linear induction motors and magnetic levitation are the principal themes of this collection of 12 articles about ground transport of the future, although air-cushioned hover systems are also discussed. With little prospect of these types of fast land-based transportation becoming established in Europe or North America in the near future, this volume necessarily invites considerable speculation on which types of levitated vehicle will eventually find favour.

The importance of the linear induction motor as the preferred means of propulsion is acknowledged by the extensive treatment given to its analysis and design. These sections and those describing levitation projects in Canada, Japan, France and America provide interesting material within the grasp of third-year engineering undergraduates.

The book is less convincing in those sections dealing with transportation systems of the future and one would have liked to have seen a broader view taken here. In Britain, where rail traffic is actually falling year by year, any limited investment can be expected to be made available for public transport. One has to be wildly optimistic to believe that an expensive replacement for the present inter-city rail service, such as the MAGLEV train, offering relatively modest time savings, is a realistic possibility. Nevertheless, eventually, alternatives will have to be developed and, even if British Rail remains wholly committed to wheel-on-rail trains, there are potential opportunities abroad where land is more plentiful and investment capital more readily available.

We still await a full-scale demonstration of a stable, economical and safe suspension system which would persuade politicians and the general public to invest in transport without wheels. In the meantime, it would be prudent for Britain to invest heavily in further development of the linear motor, which should enjoy a major role in future transportation systems whatever type of levitation is used.

Charles Turner

Bookwatch briefs



This structure (borrowed from the snail?) is a "turnover" bridge which carries a towpath from one side of a canal to the other. A reason for the revival of interest in canals is the charm of such architectural relics to be found along them. Anthony Burton affectionately describes some "favourites" in *Backdoor Britain* (Deutsch, £4.95). He journeyed from London through the Midlands, York-

shire and Lancashire and back again down the Oxford canal. The picturesque view with the horrors of modern Birmingham, where, surprisingly, there is a greater length of canal than in Venice. (The Amsterdam of the Midlands?) His book can be recommended either as a light travel book, or for its low-down on some little-known canals. J.M.

A safety handbook for science teachers, by K. Everett and E. W. Jenkin (Murray, £2.60), is a handy and attractive, 98-page reissue of the 1973 edition. Following an introduction are chapters on safety in laboratories and workshops, biological hazards (including fieldwork), fire, first aid, and the teacher and the law. For this last chapter alone the book is worth purchasing. The complex but vitally important Health and Safety at Work Act is succinctly summarised by the authors.

Then follows a bibliography of relevant literature with the accent sensibly concentrated

on Department of Education circulars. Finally the authors have scanned issues of *School Science Review* from 1919 to 1976 and listed alphabetically all the hazards mentioned. The total effect is a book that should be essential reading for all teachers and student teachers of science. R.F.

Ecological factors in human development, edited by H. McGurk (North-Holland US\$14.75), looks chiefly at the influence of ecological factors in child development as opposed to the environmental ones which have formed the basis of many previous studies of behavioural development. Consequently, this volume concentrates on interactions between the organism (=person) and its total enduring environment.

Twenty papers, based on the proceedings of the Third Biennial Conference of the International Society for the Study of Behavioural Development (1975), are included. These cover topics ranging from theoretical issues, like problems in comparing environ-

mental changes and effects at different ages, through ecological factors in cognitive development and development under adverse conditions, to problems of cross-cultural psychology. An overview by Uri Bronfenbrenner forms the final contribution. P.J.B.

Instruments of darkness—the history of electronic warfare, revised edition by Alfred Price (Macdonald and Jane's, £5.95). Not so much a history of electronic warfare as an entertaining account of Second World War radar countermeasures development written by someone with first-hand experience. Those who watched the BBC series *The Secret War* can read about much of the material in those programmes since the author was historical advisor to the series. Contemporary electronic warfare is Big Science and Big Business and, unsurprisingly, very complicated, so much so that military experts and amateur buffs are alike in being lost without recourse to endless handbooks and manuals. But in the early days, described in this book.

NEW *from* BUTTERWORTHS

REMOTE SENSING OF THE TERRESTRIAL ENVIRONMENT (Colston Papers No. 28)

R.F. Peel, L.F. Curtis & E.C. Barrett

An up-to-date review by leading experts of some of the ways in which the techniques of remote sensing, developed mainly for space research, could be used to increase our knowledge of the Earth itself and achieve a better evaluation of its resources.

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Review

continued

you can marvel at the ingenuity of individual boffins and the daring exploits of Biggles's style pilots. The publisher's explanation that the chapters added (since the first edition in 1967) on the war in Vietnam and the Arab-Israeli conflicts are scanty because much of the information on these events is still classified, is singularly unconvincing. Several books and a lot of hard data are openly available on these more recent "electronic" wars. F.H.

Noah's ark is stranded, by Björn Burglund (Macdonald and James, £6.95), is but one of a large number of books on African wildlife of varying quality. Alas, it seems to be an

entirely unnecessary addition to the list. The text is a curious hotch-potch of facts and statistics thrown together with the author's impressions and philosophical discourses. It is a sad combination. The facts are often out-of-date (the original was published in 1973)—and in any event the format of the book precludes any use being made of it as a work of reference. The philosophy—like the facts upon which it is based—is remarkably unoriginal, and only likely to interest someone who has not read anything else on the subject.

I suspect that the text is to a certain extent an excuse for the 100 or so photographs, mainly by Ingemar Berling.

However, although attractive, they are by no means exceptional—and the printing is mediocre. I can best describe the book as unfortunate—the author's motivation is undoubtedly sincere, but the result is not a success. J.A.B.

In Make your own electricity (David and Charles, £3.95) Terence McLaughlin attempts to tell anyone how to rig up an alternative electricity supply, or how to dispense with the national grid altogether. It is sensible, brief and fairly practical, with simple explanations of almost everything from the kilovolt to the home-made inverter.

The author does particularly well in dealing with generators

and dynamos—something about which it is often difficult to find information in the new vogue for solar and wind-power—and also when dealing with practical home-made electronics.

Unhappily the same cannot be said for his knowledge of mechanical engineering—and anyone trying to build a substantial wind-powered device on the basis of his advice is likely to undergo a major catastrophe. His four brief pages on water power are hopelessly inadequate. The tone is very often simplistic, sometimes downright paternalistic. I'm afraid better books are available (particularly from the United States).

R.C.

Art

Opal: the rainbow gem

by Laurence Hope
Institute of Contemporary Art,
London, until 5 June

According to an Australian aboriginal legend, the opal imprisoned the rainbow in the earth. Therefore Laurence Hope, born in Sydney, persuaded his offspring to dig for opals at Lightning Ridge in NSW Australia, got hold of a non-geological microscope, looked down the tube, and marvelled.

The ICA exhibition is the result of his experience. Apart from a self-portrait showing him suffering from mumps—bandaged like a bespectacled, though colourless Van Gogh—

there are photo-micrographs of views of opals and acrylic paintings which these gemstones have inspired Hope to paint. I am going to be brutal about the latter, so let me get this over and done with.

The press release says that the subject matter of this exhibition dictated an abstract approach. . . . To be abstract, a work of art should have no reference to the visible world. Abstract is not a synonym for shorthand or sketch. Admittedly, few of us have looked at opals under a microscope: on the face of them, Hope's acrylics therefore appear to be abstract. But the approach is concrete and highly representational. Too highly so, as follows from a comparison of the photographs and the paintings.

Moreover, the latter suffer from the disastrous overhead lighting meted out by the ICA: a shortcoming in underpaint is aggravated by horizontal brushmarks casting nasty shadows, and obliterating what little luminosity emerges from the sombre backgrounds.

None of this can obtrude on the splendid Cibachrome photographs. These are taken at various magnifications with a maximum of $\times 5400$, and at differing depths of focus. With the stone offering a kaleidoscopic range of colours, yet, unlike in a kaleidoscope, not in a single plane, the touch of art lies in one's choice. Which view is going to be photographed, which shown to the inquiring eye? And what is to be done with the prints once

they are produced?

Although Hope's occasional lapse into garishness is there for all to see, it is his sense of blue which pardons it. His photo-mosaics breathe almost a spiritual beauty, and those fortunate enough to have seen the stained-glass windows at the Sainte-Chapelle in Paris or the cathedral of Chartres will see the link.

I understand that Cibachrome is fast, and hope so for the sake of these prints. Enlarged even more, they provide the raw-material for wallpaper and for textiles, perhaps for glazed tiles, and, to complete the cycle, for large-scale transparencies. In any event, that aboriginal myth rings jolly true to me.

Robert Weale



Left, "Blue Cosmos", by Laurence Hope, acrylic painting inspired by opal microphotograph (right, $\times 400$)

Heritage

It was a shrewd move on the part of the Director's Office at the British Museum (Natural History) to throw a spotlight on a major research department when launching its latest public exhibition in the Hall of Human Biology. Secretary of State for Education and Science, Mrs Shirley Williams, officially opened both the new Palaeontology Wing and "Human Biology—An Exhibition of Ourselves" on 24 May.

The palaeontology collection and staff at South Kensington suffered for too long the discomforts of being scattered often in unsatisfactory accommodation. But as one young researcher cynically put it: "At least we now feel we've moved from the Lower Palaeozoic to somewhere in the Mesozoic". The new seven-floor wing accommodates in its 10 000 sq metres over 7 million fossil specimens and a departmental staff of 70.

From the displays of ongoing research it is evident that the department is beginning to move into the Recent. The range of activity em-

braces microfossils to huge reptiles, measurements of variation in man, past and present, and from pure research to investigations of direct application to oil prospecting. What may yet become a marker fossil for the current state of palaeo-research at the BM(NH) is an elegant electronic data processing system, incorporating a mini-computer for indexing fossil types—classification, location and stratigraphy.

The construction of the new quarters began in 1970 and was completed in 1975. Certainly the two-year delay in the official opening meant that last week a focus could be given of the triple role of the institution — curatorial, research, and public display. Such diplomacy should have acted as a sop to those fearful that the museum's new democratic tendencies are getting out of hand. If a new research gallery gets opened each time a new phase of the public exhibition is inaugurated, there will be few complaints from the curators/researchers...

Exhibition of yourself

"It's all rather gimmicky for me" muttered one distinguished looking academic as he began the journey through the exhibition at the British Museum (Natural History), London, that was supposed to tell him about himself.

Well, if you think that a galaxy of flashing lights and ringing bells, pulling and pushing levers, and—most important of all—becoming part of the exhibit through being enticed into asking and answering questions, then you might agree with the perplexed academic. (He was, incidentally, later seen playing enthusiastically with a machine which helps to demonstrate speed of learning, to the accompaniment of loudly ringing bells each time he punched the right button!)

The exhibition is a new adventure for the BM(NH), but it will be the forerunner of several similar flirtations with a distinctly new approach to exhibitions if this one is deemed successful (see *Heritage*, 3 February, p 293). There are bound to be problems, complaints, and some rethinking, but it will be surprising if it isn't judged a hit.

The idea is that you learn something about how your body and your brain work. Unlike most glass-cased museum exhibits, this one cannot be passed by with a glazed look and a brief glance at an inadequate explanatory note. Here you have to make an effort, not just in reading but in thinking: that's unusual, and in the end it's more productive.

In a grand hall that until recently housed cases of insects and fish, a series of "space-age" modules are linked together to form a squirming journey of exploration from the moment of human conception, through the mechanics of bone and nerve action, past the versatile hormones, and finally onto an experience of the meaning of perception. At times the pace of the journey seems relentless, torrents of information sweeping you on. But the repeated involvement in the information-peddling process buoys you up.

"Pull one of the levers", an innocent notice beckons. You do, and immediately are asked "What have you just done?". No, not an admonition for



meddling, it's the beginning of an exploration of the co-ordinated series of events between the perception of information in the environment and the decision to act upon it.

Arrestingly dramatic film stills accompanied by disconcertingly real sound track are the beginning of an inquiry into the many roles of hormones—in this case the effects of adrenalin in mediating the fright reaction.

Half way round, a sign offers you water at a drinking fountain. But if you imagine that it's there to care for your comforts alone, then you are wrong: it is your brain that is being offered sustenance too—yet more knowledge. "Drinking", you read as you bend to drink, "is part of the process of homeostasis." And if you are unsure about how to pronounce the word, you're helped out there: "home-ee-oh-stay-sis". It goes without saying that you quickly learn what it means, too.

There is much fun to be had in exploring perception, and it's far more instructive than simply being offered the usual string of optical illusions. There is a strong emphasis on

psychology in the exhibit. Certainly this is something one does not get at the "Biology of Man" exhibition at the American Museum of Natural History, in New York. Some of the psychology, however, is more than a little taxing: one puzzled girl really meant it when she said to her friends "I don't understand that at all". Alas, she will not be the only one.

Most of the modules in the exhibit are excitingly vigorous. But the exhibition begins in an uncharacteristically ponderous way with a description of the many different cell types in the body. This kind of detail would have been better included in the body of the exhibit. That they weren't is probably due to a too tight adherence to the desire to build up a progression of knowledge about the body. But this is a minor quibble.

The notion of involving the public in the exhibit really works, as it should when the specimen on display is your self. But as an exhibition tactic in general it is an important advance too.

Richard Fifield and
Roger Lewin

Letters

Engineering places

Sir,—I would not care to make any very important engineering structure using the "Blueprint for revival" ("The great engineering debate", 5 May, p 271) produced by John Stansell and Nicholas Valéry.

First of all, they rely on the Prime Minister's alleged statement in Oxford last October that there are "now" 30 000 vacant science and technology places in British universities and polytechnics. The Prime Minister himself made it perfectly clear in the House of Commons on 28 October, that he was not referring to the current (1976-1977) year, for which, on the same basis, his figure would be 27 000.

But, much more important, Gordon Oakes of the DES also made it clear in the House on 2 November that this estimate is based merely on physical capacity and takes "no account of the availability of staff and other resources which also determine the number of students that may be accepted." There may well be more square feet of lecture theatre seating than bottoms to fit on to them (and why not, since building costs are rising?) but as any admissions tutor here will tell you, applications are way up, all resources are already stretched and future admissions must be tightly controlled.

That round and wretched figure of 30 000, and all derivations from it, should really be laid to rest.

Secondly, they quote "First Destination of University Graduates 1974-1975" as the

authority for the statistic that "less than a quarter" of new graduates enter industry and commerce. The Department of Employment spokesman in the Commons on 27 April stated as 53 per cent the percentage of new graduates entering employment who had gone into industry and commerce. Both figures are correct, but pretty meaningless. Obviously a lot of graduates proceed to further training, or to research or simply do not keep in touch with the statisticians.

Thirdly, in 1975, entrants to engineering degree courses had "remained frozen at 22 per cent" of GCE "high-flyers". Without going into the controversy about the predictive value for university performance of GCE performance, what may have been the case two years ago is certainly not going to be the case in 1977. Current applications are not merely well up in quantity, but in quality, too; or at least, on the evidence of A level grades.

Fourthly, there is the point that "industry's annual intake of QSEs has remained remarkably constant since the late-1950s" and therefore "a surplus of more than 8000 engineers is currently finding employment (?) outside industry."

Without wishing to dismiss the problem which may be contained in this raw figure, the assumption seems to be that the only fit employment for an engineer is in industry. On the same assumption, those who read Modern Greats would be limited to keeping the books of, say, the South Place Ethical Society.

Finally, while not disputing

that Imperial College is quite a sound young institution, it is certainly not the only one—except perhaps geographically—that "comes close to" the academic engineering centres of Europe and the US.

D. E. Hodgson

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Nutritional totalitarianism

Sir,—It is nice to see the editor of this journal (Comment, 5 May, p 250) use strong words such as "nutritional totalitarianism".

There is a strong rebellion afoot in Scandinavia against the propaganda in favour of unsaturated oils and margarines, and against state intervention with the national diets, among biochemists, lipid chemists, and the medical community as well.

In Norway one distinguished rebel is professor Jens Dedichsen from the State Hospital in Oslo, himself one of the original believers in unsaturated fats after the last war. In Sweden opposition has come from a highly regarded biochemist at the University of Lund, professor Bengt Borgström.

In Denmark a whole group of professors at the University of Copenhagen and the National Hospital have come out against, such as professor Poul Astrup who is now advising people not to eat margarine at all, and Jens Kondrup who has described current medical advice as "an expensive prophylactic fiasco".

Even pro-PUFA researchers such as Hans O. Bang and Jørn Dyerberg, formerly warmly promoted by the Flora Information Service, have admitted that the traditional Eskimo diet contains very low levels of linoleic acid compared with the Danish diet, and that the lower serum cholesterol levels in the Greenland Eskimos cannot be explained with the composition of the fats or the relationship between saturated and polyunsaturated fats in the Greenland diet.

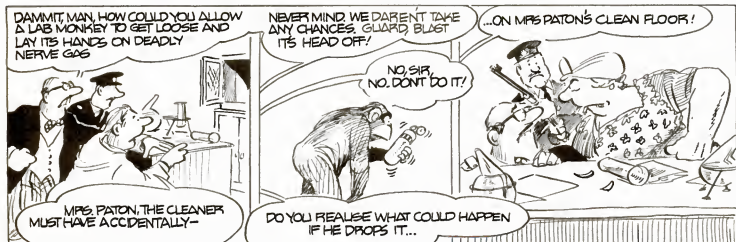
I myself have over the past seven years collected no fewer than 30 "causes" and "cures" of "heart disease"—apart from the usual ones. It is well worth remembering that when we talk about "heart disease", we are talking about four major different ones, all of which are really diseases of the blood, the arterial wall, or the liver. Moreover, even when confining ourselves to high fat levels, there are five major different types of hyperlipoproteinaemia of which the most common, type IV, requires a reduction in the carbohydrate intake.

Clearly there are strong disagreements about the role of cholesterol, about synthesis and clearance of cholesterol in the body, about plasma levels and total body levels, about even the methods used to measure the cholesterol levels.

You can lower your cholesterol levels simply by sitting down from the standing position, or by spacing your meals so that you eat five or more meals a day instead of three or less than three, though the food remains the same as before. You will need to eat the cholesterol

Grimbledon Down

Bill Tidy



equivalent of 80 eggs a day to obtain any damage in the arterial wall.

In Sweden Borgström has pointed out that the cholesterol consumption is so low anyway that any further reduction would have only a very slight effect. In Denmark Astrup claims that the risk of contracting heart disease by eating two extra eggs a day would be a mere increase from 4 per cent to 4.2 per cent.

Bernard Dixon mentions, quite rightly, that the Butter Information Council is "industry-supported". So is the Flora Information Service. The difference is that while the Butter Information Council has members from all over the world, themselves competitors in the high street, the Flora Information Service serves just one company, Unilever.

Medical finance is an intriguing subject, and it might not be a bad idea if the press and our politicians now demanded that that company make a clean breast of just how much money they have spent on research, advertising, and propaganda to promote just one particular unsaturated margarine.

In the meantime British readers might like to contemplate Norwegian claims that mortality from coronary heart disease in Norway has increased in step with increased consumption of soya oils and fats. Or they might usefully study the work done by L. H. Thomas at the Polytechnic of Wales. In the *British Journal of Preventive and Social Medicine* (vol 29, No 2, June 1975, pp 82-90) he published impressive statistical evidence showing that in Britain—especially in poorer areas in Scotland, Wales and the North West of England—mortality has increased in step with increased consumption of ordinary hydrogenated margarine and a low consumption of dairy products.

Like other lipid chemists he feels that "it is a matter of some urgency that appropriate experimental work be conducted on the possible harmful effects of chemically altered glycerides of fatty acids up to C₂₀ and of monoenoic or saturated C₂₀ and C₂₂ fatty acid glycerides."

Already other researchers have claimed that the current recommended changes in the fat composition of the national diet could lead to "disaster".

There is certainly a long way to go yet with this controversy.

Anne-Lise Gotsche

88 Lawn Road
London NW3 2XS

Translating Pidgin

Sir,—The Papua New Guinea Pidgin (or Neo-Melanesian) word derived from "finish" has a finality about it, but contrary to Dr Timothy Black "The baby who lived" (Forum, 20 January, p 159), not "brutal".

I am surprised that he has not realised that Pidgin is not a poor brother of English, but an authentic language with a standard orthography. His sentence should have read "Pikinini bilong yu i dai pinis".

Pinis marks the perfect tense. *Dai pinis* means "has died". There is an ambiguity about *dai*—it covers serious illness, trances and the like, but it would not have been resolved by telling the woman her baby was dead.

But I do not want to distract from his message, with which I agree. A girl on Guadalcanal in the Solomon Islands told me (in Solomons Pidgin, or Neo-Solomonic): "Sapos mi bonem pikinini, baebae mi torowem go long bus. Bihaen mi go long stosi." If she had a baby, she would throw it into the bush, and then go to church.

Hugh Young

1/251 Childers Road
Gisborne
New Zealand

Waste paper

Sir,—In this house large amounts of newspapers accumulate which nobody will take away without being paid to do so. I have long thought that there must be some domestic chemical process for converting what I suppose is largely cellulose into something useful.

No doubt much *papier maché* Victorian furniture could be made by boiling the paper up with glue, and I am told that cows will feed on and digest newspaper in their rumens, but I am hostile to the keeping of cows in my basement and converting newspaper into cowpat.

In my investigations I have got no further than soaking the newspapers in the bath and manipulating them into nice but useless soggy cannonballs. Surely some inventive genius, a reader of *NS*, has the on-the-spot answer to this

universal urban problem.

John Bray

5 Cambridge Gate
London NW1

Ear to the void

Sir,—May I comment on Ian Ridpath's article ("An ear to the void", 12 May, p 326) and the reported effort in this field.

The article implies that someone "out there" is going to let himself in for considerable expenditure of time and effort building beacons for a possible someone else to receive and perhaps reply to somewhere, between 10 and 20 000 years hence. If the someone out there has a culture even remotely like the Earth's I can well imagine what sort of raspberry he would get from the local equivalent of

Puzzle No 3

Letters for digits

In the addition sum below letters have been substituted for digits. The same letter stands for the same digit wherever it appears, and different letters stand for different digits.

K R A M Y R

K Q E M Y R

Y A H E K Y

Write the sum out with numbers substituted for letters.

Eric Emmet

Solution to Puzzle No 2

Two, three, four, six

	4	(i)
6)		(ii)
		(iii)
	2	(iv)
	- 3	(v)

We must first find the incorrect figure. 6 in divisor and 3 in (v) cannot both be right, for any multiple of an even number is even. And 4 in (i) and 3 in (v) cannot be right, for any number multiplied by 4 must be even. But only 1 figure is wrong.

- ∴ it must be the 3 in (v)
- ∴ since 6 and 4 are right last figure in (v) should be 4
- ∴ (iv) and (v) are—24, and this is the result of—6 times 4, (iv) and (v) must therefore be 2 2 4 and divisor must be 56.
- ∴ (iii) is 56, and 1st figure of (i) is 1

Add up from the bottom and we get:

Complete Solution

	1 4
5 6)	7 8 4
	5 6
	2 2 4
	2 2 4

tax-payers and politicians.

Prompted by this thought and the notion of evolutionary convergence (in the biological sense), let me propose "Laine's Postulate of Technological Convergence", which holds that, since the laws of physics and chemistry are everywhere and everywhere sensibly constant, solutions to common technical problems tend to converge to common optima.

From this standpoint we may now turn the whole question on its head and ask how we would detect the Earth from 10, 100, or 1000 light years (neglecting the minor local difficulty that we would have been undetectable before the advent of short wave radio).

My solution would be to listen in the region of the cosmic noise minimum (c 600 Mhz) for the spill into

Letters

continued

space of television type transmissions which might be expected to be powerful, broadband and rich in low frequency (10-80 Hz) harmonics; even though the increase in bandwidth reduces the range at which a given signal is marginally detectable.

Some nifty statistical analysis of the recorded data for autocorrelation at various time lags would, however, compensate for this loss of sensitivity, though it would require some large dedicated number crunchers to reduce the data in real time with only a 4 minute analysis window.

When such signals are detected...

David N. Laine

178 Ribblesdale Road
London SW16 6QY

Sir,—History seems to indicate that when a primitive society comes into contact with an advanced one, it disintegrates. With this in mind, by searching the heavens for other forms of intelligent life aren't we rather like a remote tribe of Indians

looking for cowboys?

If we did make contact with some race from outer space, it is very possible that they may be so different and so far advanced that by that contact our own civilisation would crumble. Alternatively we could represent such a threat to them (after all we even threaten ourselves!) that we would have to be destroyed.

L. Morley

39 Stanbridge Lane
Sandall
Wakefield
Yorks WF2 7EE

Hairy chests

Sir,—I read Mr P. E. Smith's letter (Letters, 5 May, p 297) with some amazement. It was with my impression that this side effect of margarine was well known.

I carried out my own research into this topic some years ago out of sheer idle curiosity but I did not publicise my findings because, as a simple engineer, I assumed that my counterparts in the biological and medical fields would have already investigated all aspects of the matter.

In keeping with established practice, I commenced my investigations not with human specimens but with mice. Again, in keeping with the usual methods (eg as applied in determining the potential hazards of cyclamates and, more recently, saccharin), I fed to the little beasts what was equivalent on a human scale to two tonnes of margarine per day, with an identical amount of honest butter being applied to a control group of identical rodents.

Before my experiments had progressed too far, my wife laid aside her pipe long enough to suggest that, in the light of current liberal thinking, I should give equal opportunities to both sexes and I was obliged, therefore, to include female mice in the exercise.

It is sufficient to state that positive results with these animals encouraged me to continue the investigations with guinea pigs and, thereafter, dogs, horses and, subsequently, chimpanzees.

The margarine-eating males consistently had hairless chests.

Your more astute readers will have noted, perhaps, that all the animals which I used

have what one might call *naturally* hairy chests. It was, of course, therefore necessary to shave all their chests initially in order to be able to observe the appearance or not of *unnatural* hair. (It was the need to employ this technique which prompted me to discard my original intention to commence my studies with fruitflies.)

An important corollary follows. Thanks to my wife's intervention, my work proved conclusively that not only does margarine produce hairless chests on men but, on the other hand, it is evident that butter produces hairy chests on women.

Should there be any doubt regarding this latter assertion, a moment of thought on the part of your subscribers will make them realise that in all the butter advertisements which they have ever seen, the ladies concerned have always, rather significantly I would suggest, been shown with their chests covered.

E. C. Summers

Rua Marechal Andrea 20
Pituba, Salvador
Bahia, Brazil

Sir,—I was interested to read P. E. Smith's recent letter about the possible link between hairless chests and the consumption of polyunsaturated margarines.

But he cannot be sure whether the torso in the advertisement to which he refers is pictured *after* or *before* product consumption. Who knows but that polyunsaturates may encourage chest hairiness!

Mr Smith also seems to connect chest hairiness with strength of the libido, and on behalf of smooth-skinned men I must protest. The human male evokes towards hairlessness but world population growth suggests all is well with his sexual drive.

After all, Esau was the hairy man but his baby-skinned brother Jacob had the 12 children!

Nigel Henson

Flora Information Service
25 North Row
London W1R 2BY

Binary post

Sir,—I read with interest Mr F. Quelon's letter (Letters, 12 May, p 356). A more economic and therefore a cheaper postal service could be achieved if

letters were posted in a standard sized envelope with the postal code (or binary address code) already printed on the envelope in a magnetic code.

This would be possible if a "posting machine" could be developed. I would envisage this consisting of a receiver which would only accept one size and thickness of letter. Once the letter is in the receiver the sender could type the post code on a keyboard and insert the postal fee. Pressing a "Dispatch" button would then pass the letter through the machinery, franking and magnetically encoding the envelope. In the larger post offices letters could be passed straight to sorting machinery with no need for human intervention.

I would have thought that modern technology could easily cope with this problem and a cheaper rate, say 5p, would be a great incentive to encourage the general public to conform to a standard letter. The "posting machine" itself would resemble the cash dispensers seen outside many banks, and would be no more complicated from the technical standpoint.

C. Leighton

89 Church Street
Burham
Nr Rochester
Kent NE1 3SB

Candidate

Sir,—In your otherwise admirable summary of the attempts to install Sir Campbell Adamson as the next president of the Royal Statistical Society (This Week, 12 May, p 316), you made reference to an "anti-candidate" who would stand down if elected in order to precipitate a second election.

This is incorrect. We are the nominators of a CANDIDATE, Henry Wynn, who, if elected, would seek to encourage a greater involvement of the wide variety of interests and concerns within the society and, in particular, would seek a fundamental reform of the presidential nomination procedures.

Peter Freeman

on behalf of Liz Atkins, John Bibby, Philip Brown, Ian Russell, Adrian Smith
Department of Statistics and
Computer Science
University College London
Gower Street, WC1E 6BT

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LINCOLNSHIRE AREA HEALTH AUTHORITY Medical Physics Department SENIOR PHYSICIST OR ELECTRONIC ENGINEER

To assist in establishing and developing a Medical Physics Department at the new 500 bedded Pilgrim (District General) Hospital in Boston.

The appointee will become an "outposted" member of the Area Medical Physics Department based in Lincoln from which specialist support, training and supervision will be provided as well as the facility of well-equipped workshops. Facilities will be available for routine visits to Lincoln in order to participate in team activities.

Initial work will include ultrasound diagnosis and electro-physiological measurements. A supporting Medical Physics Technician will be appointed.

Applicants must have a good honours degree and, preferably, four years' experience of Medical Physics, Electronics or Electronic Engineering. Hospital experience, although advantageous, is not essential and some initial training can be provided.

This post offers the challenge of establishing new services and applying specialist skills for the benefit of individual patients, in co-operation with Clinicians.

Salary Scale: £437-£5607.

Applications should be made in writing (job description and application forms available on request) to the District Personnel Officer, Allan House Annex, Carlton Road, Boston, Lincolnshire. (Telephone Boston (0205) 66505).

For general information, or to arrange an informal visit, telephone Mr. S. N. Mukherjee, Area Medical Physics Department, at Lincoln, 29821 extension 7122. Closing date for application forms: Monday 27 June, 1977.

THE POLYTECHNIC OF CENTRAL LONDON

School of Engineering and Science
Division of Engineering

Research Assistant

in Computer Aided Learning/Design

C2778-C2932 incl. of Phase I & II supp.

to work in the electronics and circuits area of the Division of Engineering. Candidates must have a first degree (or equivalent) in electrical, electronic or systems engineering or in physics. The vacancy exists from mid September 1977, and is for two years in the first instance. (Students graduating in Summer 1977 will be considered). The successful candidate may, if desired, submit for a higher degree. Details and application form from the Establishment Officer, PCL, 309 Regent Street, London W1R 6AL. 01-580 2020 Ext 212. Closing date 30 June 1977. Please enclose details of computing experience.

University of Riyadh, Riyadh, Saudi Arabia

Faculty of Medicine Teaching Staff for Pre-Medical Subjects

The rapidly expanding Medical College of the University of Riyadh invites applications for teaching appointments in the subjects listed below. Applications from both men and women are invited but posts have to be filled to allow for separate instruction to men and women in segregated classes for the time being.

The language of instruction is English and the following appointments are to be made.

PRE-MEDICAL

Chemistry

Assistant Professor

Female

Post of Assistant Professor is equivalent to Lecturer in the United Kingdom.

EXPERIENCE

Applicants should have some teaching experience at University level.

QUALIFICATIONS

Applicants must have obtained a PhD.

SALARIES ALLOWANCES GRATUITIES

No income tax. Currency in Saudi Arabia freely convertible and transferable.

MONTHLY SALARY

Assistant Professor SR 3600 with an annual increment of SR 200 monthly to maximum of—4600 with an increase of 12% on this added for the time being (SR 6-00 approximately equivalent to £1-00).

ALLOWANCES

Annual Housing Allowance of SR 15000 or accommodation provided by the University.

Installation Grant of SR 7500 given on first appointment only.

Gratuity dependent on length of service.

Home Leave Passages. Paid once yearly for incumbent and up to 3 dependants. Appointments. Appointments are for one year and renewable.

APPLICATIONS

Applications and detailed Curriculum Vitae (2 copies of each) including names of 2 referees to arrive not later than June 26th 1977 to be addressed to:

The Dean, Faculty of Medicine, University of Riyadh, PO Box 2925, Riyadh, Saudi Arabia.

At the same time copy of applications and 6 copies of C.V. and names of referees (there is no special application form) should be addressed to the Co-Ordinator, University of London, University of Riyadh, London School of Hygiene & Tropical Medicine, Keppel Street, London WC1E 7HT from whom further particulars are obtainable.

Interviews will be held in London on or about the middle of July 1977.

Selected applicants will be advised of their interviews.

Saudi Arabia

Opportunities in Pharmaceutical Formulation

Clinical Trial Supplies

The expansion of our clinical trials work provides an opportunity for a registered pharmacist, preferably with hospital or related experience, to undertake the preparation, assembly and distribution of medicinal products for clinical evaluation. There is close co-operation with medical and technical colleagues in U.K. and overseas.

Formulation Research

An opportunity exists in our Formulation Research Group for a graduate in pharmacy, chemistry or related discipline, preferably with previous experience in this field of activity, to undertake investigations into drug delivery systems.

Product Development

Registered pharmacists or graduates in associated disciplines are also required for our Pharmaceutical Formulation teams. The product inventory is large and presents a considerable challenge and opportunity to deploy and develop a wide range of formulation expertise.

These permanent and pensionable appointments offer good career prospects in an active and interesting scientific environment. Conditions of service include competitive salary, profit sharing and relocation help to the Nottingham area.

Please write with details to: John Hobbs, Employment Services Manager,



The Boots Company Ltd.,
Station Street, Nottingham NG2 3AA.

The Polytechnic of North London

Department of Biology and Geology GEOLOGY TECHNICIAN (Grade 2B)

required to assist in geology laboratories and workshops. Interest in geology and/or experience in draughting or photography an advantage. Qualifications ONC/D, Ordinary C & G or 2 "A" levels with three years appropriate experience.

Salary Scale: £2172-£2499 plus £465 London Weighting and 5% earnings supplement.

Apply to: Chief Technician (Geology Division), The Polytechnic of North London, Holloway Road, London, N7 8DB.

DEVELOPMENT TECHNOLOGISTS

Tate & Lyle Group R & D

Development Technologists are required for developing new process and products at our Pilot Plant building, Deacon Way, Reading, Berks.

Candidates not older than 28 years must have a minimum qualification of ONC or GCE 'A' level Chemistry. Experience with Pilot Plants in the chemical industry would be an advantage.

Basic salary will reflect ability and experience. In addition to daywork, some 4 cycle 12 hour shift work is envisaged for which a shift allowance will be paid. Other conditions of employment include annual bonus, non-contributory pension scheme, four weeks annual holiday and free meals.



Applications stating qualifications, experience and personal particulars to:
Chief Executive (NS)
Tate and Lyle Limited,
Group Research and Development,
PO Box 68, Reading, Berks RG6 2BX

University of Wales

UWIST

DEPARTMENT OF APPLIED BIOLOGY

POST DOCTORAL RESEARCH ASSOCIATE

to work with
Professor A. T. Bull on a NERC funded project on the growth of estuarine micro-organisms on chemical pollutants and the analysis of their responses to stress conditions. The research forms part of a wider programme concerned with the study of model microbial communities in continuous culture in collaboration with Dr J. H. Slater of the University of Warwick. Applicants should have experience in microbiology and preferably in the operation of chemostats.

Three-year appointment from 1 October, 1977.

Starting Salary £3333 per annum.

Requests (quoting Ref. NS) for details and application form to Personnel Section (Academic), UWIST, Cardiff, CF1 3NU.

Closing Date: 24 June, 1977

UNIVERSITY OF READING Department of Psychology ANIMAL TECHNICIAN (GRADE 4)

required to take charge of the Animal House. Applicants should possess A1AT or an equivalent qualification and experience. The technician will be responsible (under a member of academic staff) for the organisation of all routine care and maintenance of animals. The laboratory has fish, rats, pigeons and marmosets. The starting salary, which will depend on qualifications and experience, will be within the scale £2685-£3087 p.a.

Applications naming 2 referees, should be made to the Assistant Bursar (Personnel), University of Reading, Whiteknights, Reading RG6 2AH, from whom further particulars may be obtained. Quote Ref. T.516A.

UNIVERSITY OF SURREY Biochemistry Department TECHNICIANS—GRADE 5

Two vacancies exist in a newly-formed Analytical group to provide a service within the Department.

We are looking for people with an interest in instrumentation and techniques.

Experience in one or more of the following is essential:— mass spectrometry, gas liquid chromatography, high performance liquid chromatography and fluorimetry.

Salary on a scale £2885-£3267 p.a. Application forms and further particulars can be obtained from the Staff Office, University of Surrey, Guildford, Surrey GU2 5XH, or telephone Guildford 71281, ext. 452.

Departmental Manager Pilot Synthesis/R&D

At our Gosport based Research and Development Laboratories we carry out all the R & D projects for Europe, the Middle East and Africa.

The successful applicant, male or female, will be required to plan and control the work of a small group engaged in the synthesis of biologically active chemicals on a bench scale, and pilot plant production scales up to 50 gallon batch size.

The job will also involve the development and evaluation of alternative synthetic routes particularly where only tentative reaction sequences are available, and to ensure they are suitable for use on full-scale production plant.

We are looking for someone with a good Honours Degree, or Ph.D in Organic Chemistry and preferably some relevant experience.

We offer excellent terms and conditions of employment and full relocation expenses will be met where appropriate.

Please write or telephone in the first instance, for an application form, to:-

**Greg Soper, Personnel Officer,
CYANAMID OF GREAT BRITAIN LTD.,
Fareham Road, Gosport, Hants PO13 0AS
Telephone: Fareham (03292) 6131**

CYANAMID

ROYAL POSTGRADUATE MEDICAL SCHOOL

University of London
The Department of Medicine
requires a

SENIOR TECHNICIAN II IN CLINICAL CARDIOLOGY

with HNC or equivalent, to supervise 11 technical staff.

There are opportunities for participating in research in this busy and progressive academic unit. The successful applicant must be fully experienced in all cardiological techniques, conversant with modern recording equipment and will be expected to maintain a full diagnostic service and to undertake the training of student technicians.

Salary scale: £464-£5436.
Applications to the Personnel Officer, R.P.M.S., 150 Du Cane Road, London W12 0HS quoting ref. no. Z/13/NS.

CHARING CROSS HOSPITAL TECHNICIAN

required for Nuclear Medicine Department (Graded as Medical Physics Technician IV). Salary £3178 to £4129. Technician is required to join a small but busy team who undertake all standard tests on patients involving Radioisotopes, scanning procedures and tests requiring some laboratory skills. Assistance with research in other departments also given.

Applicants should have either completed training in Radiography or a scientific background. Previous experience in Nuclear Medicine is not essential but the ability to handle patients is important.

For job description and application form contact Edna Francis, District Personnel Department, Charing Cross Hospital, Fulham Palace Road, London W6, Tel. 01-748 2040 ext. 2597. Closing date for return of application forms 20 June, 1977.

AUSTRALIAN ATOMIC ENERGY COMMISSION

Applications are invited for the following two positions within the Commission's Nuclear Science and Technology Branch, which operates the Research Establishment at Lucas Heights about 30 km south-west of Sydney.

Chief, Chemical Technology Division

The research programme of the Chemical Technology Division, which currently has a staff of 71, including 37 professionals, involves chemistry and chemical engineering research in the fields of uranium ore processing, conversion of uranium oxide to uranium hexafluoride, laser techniques for enrichment of uranium, treatment of radioactive wastes and a wide range of specialised analytical methods, including electrochemistry, neutron activation analysis, spectrographic and radiochemical methods. The work of the Division includes analytical chemical services, for example for routine chemical control of the HIFAR reactor, waste treatment operations, and environmental monitoring. Facilities include well-equipped radiochemical laboratories, a high bay chemical engineering facility, hot cells and a low background analytical laboratory. Special equipment includes mass and emission spectrometers, x-ray diffraction and fluorescence analysis equipment, a range of optical spectrometers, small-scale equipment for studies of liquid/liquid extraction, fluidisation, leaching and other chemical engineering operations. The Division Chief is responsible to the Branch Head for the management of the Division and for the development of the Divisional programme in consultation with Programme Managers and other senior staff. He will be expected to give advice within his area of experience and competence on matters of Commission policy. Applicants should hold high scientific qualifications, preferably in chemistry or chemical engineering and have a proven record of research and management.

Chief, Physics Division

The research programme of Physics Division, which currently has a staff of 53, including 41 professionals, has been primarily in the fields of reactor and nuclear physics and currently includes theoretical and experimental investigation of the fission process, measurement and analysis of neutron cross section data, neutron transport, shielding and theoretical studies of reactor transients and loss of coolant accidents. Some broadening of the programme recently involves modelling studies in support of the uranium fuel cycle research programme; involvement in plasma experiment and theory is being increased, and these trends to diversification are expected to continue. Facilities include a low powered (100 kW) reactor (MOATA), a 3 MeV van de Graaff accelerator, a split-table critical facility. Theoretical Physics Section has direct access to the central IBM 360/65 computer to which are coupled local computing and interactive facilities. The Division Chief is responsible to the Branch Head for the management of the Division and for the development of the Divisional programme in consultation with Programme Managers and other senior staff. He will be expected to give advice within his area of experience and competence on matters of Commission policy. Applicants should hold high scientific qualifications with experience in reactor and nuclear physics and have a proven record of research and management.

Salaries will be at the level of Chief of Division, Level 1, currently \$A28468.

Application forms may be obtained by writing to the Counsellor (Atomic Energy), Australian High Commission, Canberra House, 16-18 Maitland Street, London WC2R 3EH, with whom applications will close on 2nd July.

**University of Riyadh
Riyadh, Saudi Arabia**

Pre-Clinical Subjects

The rapidly expanding Medical College of the University of Riyadh invites applications for teaching appointments in the subjects listed below. Applications from both men and women are invited, but posts have to be filled to allow for separate instructions to men and women in segregated classes for the time being. The language of instruction is English and the following appointments are to be made.

PRE-CLINICAL

Anatomy
Physiology

Female
Female

Assistant Professor
Assistant Professor

EXPERIENCE

Applicants for Assistant Professor Posts require some teaching experience at University level.

QUALIFICATIONS

Applicants for posts must have obtained a higher qualification after being awarded the first degree.

SALARIES ALLOWANCES GRATUITIES

No income tax. Currency in Saudi Arabia freely convertible and transferable (S.R. 6.00 approximately equivalent to £1.00).

MONTHLY SALARIES

Assistant Professor SR 3600 with an annual increment of SR 200 monthly to a maximum of £4600 plus an additional 12% of these figures added to the salary for the time being.

ALLOWANCES

Annual Housing Allowance of SR 15000 for Assistant Professors or accommodation provided by the University.

Installation Grant at the rate of 50% of Housing Allowance given on first appointment only.

Professional Allowance for registered medical practitioners.

Assistant Professors 20% of salary.

GRATUITY

Dependent on length of service.

Home leave Passages paid once yearly for incumbent and up to 3 dependants.

APPOINTMENTS

Appointments are for one year and renewable.

APPLICATIONS

Applications and detailed Curriculum Vitae (2 copies of each) including names of 2 referees (there is no special application form) to arrive not later than 26 June, 1977 to be addressed to:

The Dean, Faculty of Medicine, University of Riyadh, PO Box 2925, Riyadh, Saudi Arabia.

At the same time copy of application and 6 copies of C.V. and names of referees to be addressed to: The Co-ordinator, University of Riyadh, University of London, London School of Hygiene and Tropical Medicine, Keppel Street, London WC1E 7HT, from whom further particulars are obtainable.

Interviews will be held in London about second half of July 1977.

Selected Applicants would be advised of these interviews.

Saudi Arabia

**SUNDERLAND
POLYTECHNIC**

Polytechnic research assistantships

leading to the degree of MPhil (2 years) or PhD (3 years) of the CNA, are available in the coming academic year for work on the following projects:

Faculty of Engineering

Candidates should have, or be confident of obtaining, good honours degrees in Engineering, Mathematics or an appropriate science subject.

Heat Transfer (Ref: Eng 1)

Work will involve both theoretical and experimental investigations into parameters influencing thermal performance.

Behaviour of Concrete at Cryogenic Temperatures (Ref: Eng 2)

To study the behaviour of concrete under impact at cryogenic temperatures.

Repeated Load Testing (Ref: Eng 3)

Establishing the behavioural characteristics of brittle and other types of foundation materials.

Underwater Communications (Ref: Eng 4)

An investigation of interactive signal processing with a mini computer system and its application to sonar.

Computer Engineering (Ref: Eng 5)

Investigation of the use of micro-processors used on digital filtering elements. The project will involve the use of computerised design techniques.

Tribology (Ref: Eng 6)

The measurement of rotational speed in bearings using laser anemometry. The work is intended to lead to the development of an instrument to measure roller and ball speed in a rolling contact bearing.

Faculty of Science

Energy Analysis of Natural Energy Sources (Ref: Sci 1)

Applicants should be good honours graduates in science and engineering. The successful candidate will join an established research group and concentrate on determining energy inputs and outputs of hydro and tidal power schemes.

The salary for Research Assistants is £2535 - £126 x 2 to £2787 per annum.

Please quote the project reference number when applying for an application form(s) and further particulars, which are obtainable from the Personnel Officer, Sunderland Polytechnic, Chester Road, Sunderland SR1 3SD, and should be returned as soon as possible.

University of Wales

UWIST

**DEPARTMENT OF
APPLIED BIOLOGY**

**RESEARCH
TECHNICIAN
IN MICROBIOLOGY**

to join a NERC funded programme on the physiology of estuarine micro-organisms in relation to chemical pollutants. Experience in the use of continuous-flow fermenters would be an advantage.

Three-year appointment from 1 October, 1977.

Starting Salary £2455 per annum.

Application forms (returnable by 24 June, 1977) from Personnel Section, UWIST, Cardiff CF1 3NU.

Research Biochemist

Roche Products Limited is part of a major international Pharmaceutical Company based in Switzerland and is itself one of the leaders in the industry in the United Kingdom.

Our Biochemistry Department currently has an opportunity for a Research Biochemist to assist a team, under the direction of a senior biochemist, investigating the role of enzymes, proteins and peptides in chronic degenerative diseases. Candidates, male or female, should preferably have had practical experience in protein fractionation, characterisation and enzyme analysis and should not be averse to working with laboratory animals. A knowledge of biochemical immunology would also be an advantage.

The grade at which the appointment is

made will depend upon the qualifications and experience of the successful candidate. However, minimum qualifications will be HNC in Biochemistry or related subjects, up to degree level.

Our Biochemistry Department is located in modern laboratories in Welwyn Garden City where facilities and working conditions are excellent. Conditions of Service are above average and in an appropriate case the Company may consider assistance with relocation.

If you would like to apply for this post, please write briefly or telephone (Welwyn Garden 28128) for an application form quoting reference number RB21 to the Personnel Research Department, Roche Products Limited, PO Box 8, Welwyn Garden City, Herts AL7 3AY.

ROCHE

**Imperial Chemical Industries Limited
Agricultural Division,
Jealott's Hill Research Station
Bracknell, Berkshire**

FIELD TRIALS OFFICER

Grass, Cereals and Fertilizers

A vacancy exists for a Field Trials Officer to be responsible for field trials at JEALOTT'S HILL RESEARCH STATION and several farm sites. These experiments investigating the fertilizer requirements of crops are an important part of the Company's fertilizers sales support.

Suitably qualified persons aged not more than 35 years will have a good degree in an Agricultural Science and at least two years post graduate experience of agriculture and/or field experimentation. There are opportunities for the publication of results in the scientific and agricultural literature.

The Company operates house purchase, profit sharing and contributory pension schemes and offers financial assistance towards removal expenses.

Apply in confidence, giving age, qualifications, experience etc to:—

**M A J W Pegg, Personnel Department
Imperial Chemical Industries Limited
Agricultural Division, PO Box 1
Billingham, Cleveland TS23 1LB**

Searle Research Laboratories

Senior Chief Animal Technician

We are currently looking for a Senior Chief Animal Technician to take charge of our SPF rodent breeding unit and experimental animal units. These units employ about 20 staff and cover a wide range of activities providing specialised services to the scientific departments.

Applications are invited from established and experienced animal technicians who are Fellows of the Institute of Animal Technicians. The successful applicant will also have experience of experimental work, a specific knowledge of the production of inbred animal lines, and proven managerial ability.

Salary will be according to qualifications and experience.

Conditions of employment include four weeks' holiday, and other benefits are Pension and BUPA schemes, social club and subsidised cafeteria.

Please apply to Mr G Jenkins, R & D Division, G D Searle & Co Ltd, Lane End Road, High Wycombe, Buckinghamshire—telephone High Wycombe 21124, extension 3272, quoting reference SCAT/R22.

**SEARLE
Research**



FORENSIC SCIENTISTS BIOLOGISTS

to fill two Scientific Officer vacancies.

The Biology Division of the Laboratory deals with the identification and comparison of all materials of biological origin which occur in connection with criminal offences. This includes the grouping of blood and other body fluids by serological and biochemical techniques, examination of fibres and botanical material using microscopy and spectrophotometric methods. Other subjects include paper, dyes, microbiology, hairs, foodstuffs, histology etc.

Age: Under 27

Qualifications: Degree, HNC or equivalent (Those who qualify this summer are also eligible to apply).

Salary: £2614-£3992

In addition a supplement of £6 per week is payable plus 1977 pay supplement of 5% of total earnings (up to a maximum of £4).



Application forms (to be returned by 23rd June 1977) and further details are available from:- The Secretary, Room 213 (BIO/NS) Metropolitan Police Office, 105 Regency Street, London SW1P 4AN or telephone 01-230-3122 (24 hour answering service)

METROPOLITAN POLICE

Health Physicist

The Daresbury Laboratory has a vacancy for a Scientific Officer in the Health and Safety Group.

The Laboratory is at present constructing a 2 GeV electron storage ring for synchrotron radiation research and a tandem Van de Graaff accelerator with a maximum terminal voltage of 30 MeV for research on nuclear structure.

The successful applicant will be required to carry out radiation surveys, assist in analysing radio-active material, developing health physics instruments, assessment of shielding requirements in and around the accelerators and experimental areas; and to help with:- effective health physics supervision of work on radio-active materials, the use and safety of sealed sources and the disposal of radio-active waste.

Appropriate training (if necessary) will be given and with experience the successful applicant will be expected to become a fully qualified health

physicist advising staff on all aspects of radiation safety.

Applicants, male or female, should possess a good honours degree in a relevant scientific discipline. They should also have a knowledge of the physics involved in the production and absorption of all types of ionising radiation. Experience in instrumentation and computer programming would also be an advantage.

Appointments will be made according to age, experience and qualifications on the following salary scale: Scientific Officer: £2149-£3527 plus £113 per annum plus 5% of total earnings in pay supplements.

There is a non-contributory superannuation scheme and a generous leave allowance.

Closing date: 20 June, 1977.

Please write (or telephone Warrington 65000 Ext. 467) for an application form, quoting reference DL/587/5 to:

SCIENCE
RESEARCH
COUNCIL



DARESBURY LABORATORY

Personnel Officer,
Science Research Council
Daresbury Laboratory,
Daresbury,
Warrington WA4 6AD.

The Polytechnic of North London

Department of Biology & Geology RESEARCH ASSISTANT

A Research Assistant is required for experimental fieldwork in an SRC-sponsored investigation of polymorphic terrestrial snails, to work full-time at the Leonard Wills Field Centre near Minehead, Somerset. The appointment is for three years from September 1977 and the successful candidate will be expected to register for a higher degree.

Salary scale: £2244-£2406.

Apply, giving qualifications and names of two referees, to:

Dr C. R. Bantock,
Department of Biology and
Geology, The Polytechnic
of North London, Holloway
Road, London N7 8DB.

ELECTRONIC CIRCUIT DESIGN

PHYG 5181

Do you enjoy the challenge of using advanced technology to solve complex interdisciplinary problems. Are you thoroughly conversant with the use of discrete components, micro-circuit amplifiers, function generators, TTL and CMOS techniques? Can you design both analogue and digital circuits? We have one vacancy for a senior technician in a small team providing a comprehensive design, construction and maintenance service for teaching and research.

Candidates must have at least 9 years' relevant experience including 2 years' design work. HNC standard is required and the ability to supervise other staff is essential. Familiarity with medical electronics an advantage.

Salary on University Technical Scale, Grade 6 (6315 x 7-43850).

Letters of application stating age, qualifications, experience and the names of 2 referees to:

Administrator, University of Oxford, Department of Physiology, Parks Road, Oxford OX1 3PT.

Further details from: Will Laycock, Supervisor, Electronics Group, Oxford S7451.

SUNDERLAND POLYTECHNIC

Department of Physical Sciences

Materials Science Division RESEARCH ASSISTANTSHIP IN CORROSION SCIENCE (Ref Matsci 1)

An honours graduate is required for research into the mechanism of pitting corrosion of aluminium. Applicants should be qualified in Materials Science, Metallurgy or Chemistry and the successful candidate will be expected to register for a higher degree.

Salary scale £2535 plus £126 x 2 to £2767 per annum.

Please quote the project reference number when applying for an application form(s) and further particulars, which are obtainable from the Personnel Officer, Sunderland Polytechnic, Chester Road, Sunderland SRI 3SD, and should be returned as soon as possible.

Research Officer Materials

Is required in the Scientific Services Department based at the new laboratories at Regional Headquarters, Bedminster Down, Near Bristol, but until early 1978 will be located at Portishead, Nr. Bristol.

The successful candidate will become a member of a group concerned with the investigation of welding problems at the Power Stations in the Region and be involved with weld failure diagnosis, developing methods and materials for weld construction and repair, and assessment of the integrity of welded components. The work will be either short-term plant investigations, or be longer term involving a variety of laboratory investigations.

Applicants should possess a good degree in metallurgy/material science. Experience with welding or other related metallurgical work, and a practical knowledge of Fracture Mechanics would also be desirable. Visits to power stations throughout the Region will be an essential part of the work so that a current driving licence will be required.

Salary will be within the following ranges according to age, experience and qualifications, £5280-£6430/£7030, or £4530-£5880, or £2730-£4980 per annum plus appropriate salary supplements.

Application Forms may be obtained by ringing Bristol 32251 Ext. 18, or by writing to the Personnel Manager. They should be completed, quoting the vacancy notice number R6/77 and returned by not later than 22 June, 1977.

**Central Electricity
Generating Board**
South Western Region
Oakfield Grove, Clifton,
Bristol BS8 2AS



Food Technologist up to £4,600 p.a.

This new appointment in the Research and Development Dept. of Express Dairy Foods at South Ruislip, is intended to play a key role in the formation of the basis for a customer service group.

The man or woman selected will initiate and progress new food ingredients for a wide range of product areas and, initially, this will concern mainly the organisation of product research facilities and suitable scientific assessment methods.

Essential qualifications will be a degree, HNC or equivalent, together with several years' practical experience in the food industry, preferably where this has involved Product Research and Ingredient Development. Flexibility and the ability to write clear reports are also important.

The position offers considerable independence and job interest. Together with the benefits normally associated with a large, progressive company. Please write for an application form to Mr W. S. Hawkes, Express Dairy Foods Limited, Research and Development Dept., Block X, Victoria Road, South Ruislip, Middlesex HA4 0HF.



Analytical Chemist Plant Health R&D

Cyanamid International, a leader in the pharmaceutical, chemical and agricultural product fields, seek an Analytical Chemist for their Gosport based R & D unit, to work on projects for Europe, the Middle East and Africa. The work is primarily research development and implementation of new and improved analytical techniques for residue methods associated with plant health products. Our range of interests also include Pharmaceutical and Animal Health Products.

The laboratories have modern equipment and facilities including gas and high speed liquid Chromatographs, Polarograph, recording U.V. and I.R. Spectrophotometer.

Ideally we are looking for a man or woman who has recently qualified to degree or G.R.I.C., standard in Chemistry, or expects to do so this summer.

Candidates qualified to H.N.C. standard with experience in a relevant R & D field will also be considered.

This is a new position created by the expansion of our Analytical Services Unit, due to new product development supporting increased sales in this international division.

We offer an excellent starting salary, good prospects for promotion and generous re-location benefits where necessary. In the first instance, please write for an application form to:

Mr. G. J. Soper, Personnel Officer,
CYANAMID OF GREAT BRITAIN LIMITED,
Fareham Road, Gosport, Hants. PO13 0AS.
Telephone: Fareham (03292) 6131

CYANAMID

**The Hospital for Sick Children
Great Ormond Street
London, WC1N 3JH**

Cardio-Respiratory Measurements Technician

to assist in the day-to-day work of a respiratory function laboratory and help with current research projects.

Previous experience in this, or a related field, with an understanding of instrumentation principles and practice will be an advantage. The work will involve direct contact with young children.

The post is financed by a research grant for a period of 18 months, with a possibility of extension at the end of that time.

Time off for further studies will be considered where appropriate.

Salary on Physiological Measurements Technician scale, £2208-£2538 plus £2354 London Weighting Allowance, plus £312 non-enhanceable pay award, plus 5% supplement to earnings.

For further details and application form, please contact Group Personnel Office. Tel: 01-405 9200 Ext: 228. Closing date: 16th June 1977.



Wellcome

Wellcome
Reagents
Limited

Production Technologist Sterile Products

The Wellcome Foundation Ltd, a major British-owned international pharmaceutical organisation, manufactures and markets a wide range of chemical and pharmaceutical products. Current world-wide sales are in excess of £290 million.

For our main manufacturing site, at Dartford, Kent, we are currently looking for a Production Technologist to join the Technical Support Unit of Sterile Products Department which manufactures insulin vaccines and injections for medical and veterinary use. The work will involve providing a technical service to line supervisors and management, and assisting with the day to day running of the department. Additional functions of the Technical Support Unit will include trouble-shooting with respect to machine and component faults, the evaluation and commission of new equipment and technological developments within the Department.

Ideally, candidates should have HNC or equivalent and possess 3 years' experience in the pharmaceutical industry or a similar field involving aseptic techniques.

Salary will be negotiated dependent on ability and experience in the range £3500-£4500. Excellent benefits include 4 weeks' holiday, subsidised restaurant, generous assistance with relocation expenses where applicable and pension, life assurance and sick pay schemes.

For an application form, please write to or ring

Mrs M. Jack, Personnel Officer,
The Wellcome Foundation Limited,
Temple Hill, Dartford, Kent.
Tel: Dartford 23488, ext. 2062.



The Water Research Centre, with its two main laboratories, one at Medmenham, Bucks, and the other at Stevenage, Herts, is the national centre for water research in the United Kingdom. With a total staff of over 500 it is one of the largest water research organisations in the world. It is financed principally by the Regional Water Authorities as Members and is grant-aided by the Department of the Environment.



Microbiologist Drinking Water Quality

Young graduate microbiologist required to join research team working on problems concerned with the maintenance of drinking water quality through water mains and in domestic plumbing systems, including evaluation of alternative indicator organisms, assessment of the efficacy of disinfection and the effects on water quality of new plumbing materials.

Salary depending on age and experience in the grades £2,278 to £3,739 or £3,449 to £4,721, plus supplements up to £522, equivalent to SO/HSO in the Civil Service but with National Water Council Contributory Pension Scheme.

Write or telephone for an application form,
quoting post no. 157 to —

WATER RESEARCH CENTRE
Medmenham Laboratory, Henley Road, Medmenham, P.O. Box 16,
Marlow, Bucks SL7 2HD. Telephone: 049-166 (Hambleton) 531

OXFORD POLYTECHNIC Department of Catering Management Technician

Food Science

(£2529 - £2853 plus
supplement £312)

A technician is required to take post no later than September. Applicants should have an interest in food processing and analysis and should preferably hold graduate or equivalent qualifications in food science or applied chemistry. Placement will be in accordance with age, experience and qualifications. Well qualified applicants will be eligible for £42 or £72 pa qualification pay. It is expected that a further supplement will be payable in July.

Application forms and further particulars may be obtained from Mr. J. B. Administrator, Oxford Polytechnic, Oxford, OX3 0BP.

THE WEST OF SCOTLAND AGRICULTURAL COLLEGE Department of Microbiology

Applications are invited for the post of

LECTURER

in the above Department. Applicants should have an Honours degree in Microbiology or equivalent. Experience in food and/or dairy microbiology will be an advantage.

Duties include participation in the teaching of Microbiology to students of Food Technology, Agriculture, Horticulture and Poultry Husbandry. Facilities exist for research and the Department also provides specialist advice through the College Advisory and Development Service.

Salary, according to age, qualifications and experience, will be on one or other of the following scales—

Grade IV—£2295 (Honours—1st or 2nd Class—£2442) rising to £3100. III—£3321 rising to £3778. Plus

Phase I and Phase II Supplements. Application forms and conditions of appointment are obtainable from the Secretary, The West of Scotland Agricultural College, Auchincruive, Ayr KA6 5HW, with whom applications should be lodged not later than 27 June, 1977.

THE UNIVERSITY OF SHEFFIELD

Department of Biochemistry

Applications are invited for a post of
POSTDOCTORAL RESEARCH ASSISTANT

in the above Department, financed by a grant from the MRC to Dr Pauline Harrison, tenable from 1.9.77 to 30.9.79. Initial salary up to £3075 p.a. on Range 1A. A protein crystallographer is required for the X-ray analysis of the iron storage protein, ferritin at high resolution. Further details from Dr Harrison in the above department, to whom applications, with names and addresses of two referees should be sent by 21 June, 1977. Quote Ref. A 569/H.

APPLIED MATHEMATICIAN

London up to £4587

The Mathematics and Computing Division at London Research Station is responsible for providing expertise in mathematical and applied computing techniques for the solution of problems associated with the natural gas transmission system. The Applied Computing Group within the Division requires a graduate in Mathematics, Science or Engineering to work on these problems. You will also be required to work on a new computer-aided teaching system, and to assist in the organising and presenting of computer oriented courses.

In addition to the degree, you should also have 1-2 years' experience of writing computer programs; teaching experience would be an advantage but is not essential as the main requirement is an enthusiastic approach to this expanding area. We are able to provide training in appropriate subjects as required.

Starting salary will be according to qualifications and experience and will be within the range £2361-£3819 + £456 Inner London Weighting + £312 flat rate supplement.

For further details please contact the Research Secretary, British Gas, London Research Station, Michael Road, London, SW6 2AD, for an application form, quoting reference RD/4006/53/LRS/NS.

BRITISH GAS

City Hospital

Medical Physics Department

TECHNICIAN GRADE IV

A technician is required to join the electronics section of the Medical Physics Department, City Hospital, Nottingham.

The post involves all aspects of electro-medical instrumentation, i.e. servicing, modification and development.

Qualifications — O.N.C., H.N.C. or equivalent in appropriate subjects. Salary is £2346 to £3267 plus £312 plus 5% per annum earnings supplements.

For further information contact the Area Chief Technician at Nottingham 46161, extension 641.

Application forms from Personnel Services, Valebrook House, Sherwood Hospital, Hucknall Road, Nottingham. Telephone Nottingham 600459 anytime.
Closing date: 14th June 1977.

**NORTH NOTTINGHAM
HEALTH DISTRICT (C)**
Nottinghamshire Area Health Authority (Teaching)

Clinical Research Associate

Applications are invited for the above position within the Clinical Pharmacology Department at Brockham Park.

The function of the Clinical Research Associate will be to assist the Clinical Pharmacologists in their appraisal of novel pharmaceutical compounds. Duties will include assistance with planning of studies, writing protocols, collecting and compiling data, liaising with other departments and monitoring clinical programmes. Responsibilities will be of both an administrative and scientific nature and the job should appeal to those with an interest in allergy, immunology and/or antibiotics.

The successful applicant is

likely to be a university graduate now of mid-20s age. Having gained a good honours degree in biochemistry, pharmacy, pharmacology, physiology or a similar discipline he or she will now have some years' work experience perhaps gained within the pharmaceutical industry or within a hospital. We are looking for applicants whose previous job(s) have enabled them to develop a good sense of organisation and the ability to write well.

The post will involve some travelling for the purpose of monitoring work conducted on Beecham compounds and thus it would be helpful if the jobholder owns a car.

(REF. 1405).

Registration Officer

This vacancy exists in the Co-ordination and Regulatory Affairs Department. The work concerns the editing and collation of information, involving chemical, pharmaceutical and experimental data on medical products under development for registration with the U.K. and Overseas Health Authorities.

The successful applicant is likely to be a graduate chemist or pharmacist who has already gained some registration experience. He or she will be based at our newly acquired research site near Epsom, Surrey.

(REF. 315).

If interested, please apply (enclosing brief personal and career details and quoting the appropriate reference number) to:

Mrs. M. R. Minchin, Personnel Officer, Beecham Pharmaceuticals Research Division, Brock-

ham Park, Betchworth, Surrey, RH3 7AJ. Tel. No. Betchworth 3202 Ext 55.

Beecham Pharmaceuticals

ROYAL POSTGRADUATE MEDICAL SCHOOL

University of London
SENIOR TECHNICIAN

required to service haemodialysis monitoring systems, physiological and scientific equipment. It is essential that applicants have initiative and be able to work with the minimum of supervision.

The successful applicant will be qualified in electronics and will be encouraged to design and develop medical equipment.

Salary according to qualifications and experience in the range £3726 to £4446 per annum.

Further information is available from Mr E. Gains, Principal Technician (01-743 2030 Ext. 451). Applications to the Personnel Officer, RPS, 150 Du Cane Road, London W12 0HS quoting ref. no. 3/212.

KINGSTON POLYTECHNIC

School of Chemical and Physical Sciences

RESEARCH ASSISTANT IN TRANSITION METAL CHEMISTRY

Applications are invited for the post of research assistant to investigate the use of transition metal complexes as catalysts for the reduction and oxidation of olefins that occur in natural fats.

Honours degree in Chemistry, GradRIC or equivalent qualification required. Starting salary £204 (inc supplement and London allowance). Further information from Dr W. J. Bland on extension 309. Application forms from Appointments Officer, Kingston Polytechnic, Penrhyn Road, Kingston upon Thames KT1 2EE. Tel: 01-549 1366.

Analysts: Chemists

INCO EUROPE LIMITED, the European subsidiary of the world's leading nickel producer, is engaged in refining and manufacturing activities in the U.K. Our plant in N.W. London is one of Europe's major precious metal refineries and is undergoing extensive modernisation. We currently have the following vacancies in our Technical Department:—

Chemist: Process Research and Development

A research chemist is required to join a team engaged in the development of a process to refine precious metals based largely on the use of solvent extraction. Candidates should have either a Ph.D. or other research experience, preferably in the field of precious metal chemistry or solvent extraction.

Process Investigator

An investigator is required for the Process Technology Section. The successful candidate will join a small team responsible for both process development and process control analysis, and will undertake projects of an interesting and varied nature related to current refining processes.

Analyst: Optical Emission Spectroscopy

The successful applicant will carry out development work on a new computer controlled direct reading spectrometer, equipped with d.c. arc and inductively coupled plasma excitation. He or she will be responsible, under the direction of the Chief Analyst, for developing this instrument for the analysis of precious metal materials. Previous experience of direct reading spectroscopy and computer application will be an advantage.

Analyst: X-ray Fluorescence Spectrometry

An Analyst is required to operate and continue development of a modern computer controlled X-ray spectrometer analysing a wide range of materials for both precious and base metals. We are looking for applicants who feel that they can contribute experience and original thought to our already established use of this analytical technique and who can help in planning the future use of X-ray fluorescence analysis in the Refinery.

Candidates for the above three posts should ideally possess a degree (or equivalent) and preferably should have some relevant industrial experience.

Salaries will be negotiable. Employee benefits include non-contributory pension and life assurance, four weeks' paid annual holiday, subsidised staff restaurant and recreational facilities. Where applicable, comprehensive re-location assistance will be given.

If you are interested in any of the above vacancies, then please apply in writing, giving age, qualifications and brief career details to:—

E.J. Bailey, Inco Europe Limited, Bashley Road, London NW10 6SN

Inco

INCO EUROPE LIMITED

Thames House, Millbank, London SW1P 4QF

UNIVERSITY OF LEICESTER TECHNICIAN GRADE 5

required in the Department of Microbiology to work on standardisation of fungal antigens. Post is funded for up to 3 years by the Trent Regional Health Authority. Salary in the range £2880 to £5081 per annum. Applications naming two referees should be sent by 14 June to Dr F. C. Odds, Department of Microbiology, University of Leicester, Leicester.

BUREAU TECH (SCIENTIFIC STAFF AGENCY)

Top jobs for ONC/HNC/OND/AMLT BSc. (Chem; Phys; Biol; Med. Lab. subjects)
Immediate vacancies for Point, Ink and Surface Coating Technologists.
We find you the job free of charge
Tel: 01-959 3517.

STONTHURST COLLEGE Senior Laboratory Technician

for Sept 1st, 1977, to make and repair school science apparatus and to supervise 3 laboratory assistants.
Salary range £2841-£3165. Accommodation possible. Apply stating age, qualifications, experience and present post to Head of Sc. Dept, Stonthurst College, Blackburn, Lancs.

SUNDERLAND POLYTECHNIC

Polytechnic research assistantships

leading to the degrees of MPhil (2 years) or PhD (3 years) or as CNAAs, are available in the coming academic year for work on the following projects:—

Faculty of Science

Pharmacology

Serum proteins in disease states (Ref. Pharm 1)

Phosphodiesterase inhibition and allergic disease. (Ref. Pharm 3)

Pharmacogenetics

The application of High Pressure Liquid Chromatography to the analysis of natural products. (Ref. Pharm 2)

Pharmaceutical Chemistry

Immunology of Neuroleptic Drugs (Ref. Pharm 3)

Reaction of chloropyrazolopyridines. (Ref. Pharm 9)

Pharmaceuticals

Pharmaceutical factors affecting the uniformity of content and quality control of medicines. (Ref. Pharm 4)

Interactions of micro-organisms with antimicrobial agents or other pharmaceutical materials (Ref. Pharm 10)

Survival of micro-organisms during pharmaceutical process procedures. (Ref. Pharm 7)

Quality control problems in the medical and pharmaceutical devices industry. (Ref. Pharm 6)

Therapeutic Efficacy of Anti-inflammatory Analgesics in Rheumatoid Arthritis. (Ref. Pharm 8)

Biology

Interactions between a Fish Intestinal Parasite and its Mollusc First Intermediate Host. (Ref. Biol 1)

Serological Relationships in the genus Hypoxylon (Ref. Biol 2)

Mechanism of Auxin Action in Plants (Ref. Biol 3)

The salary for Research Assistants is £2535 + £126 x 2 to £2787 per annum.

Please quote the project reference number when applying for an application form(s) and further particulars, which are obtainable from the Personnel Officer, Sunderland Polytechnic, Chester Road, Sunderland SR1 3SD, and should be returned as soon as possible.

UNIVERSITY OF NOTTINGHAM Applications are invited for a temporary post in the following department:

PHYSICS SENIOR EXPERIMENTAL OFFICER

The appointment, to commence as soon as possible, will be for one year in the first instance, but may be extended to a maximum of 3 years.
The S.E.O. will assist in the design and construction of a machine for whole body medical imaging using the new nuclear magnetic resonance methods developed at Nottingham which involve no ionising radiation hazard.
The equipment will employ modern solid state circuitry and will involve the use of a small control computer.

Applicants should have a degree in Electronic Engineering or equivalent qualification. Some experience in solid state radio frequency circuit and microelectronic applications is desirable.
The appointment will be made initially with the salary range £5010 to £5418 plus F.S.S.U.

Applications, giving age, details of qualifications, experience etc. together with the names of two referees, should be sent by 20 June to Dr P. H. Field, Department of Physics, University of Nottingham NG7 2RD.

IMPERIAL COLLEGE

Applications are invited for a **POSTDOCTORAL RESEARCH ASSISTANTSHIP** to work with an interdisciplinary team in the environmental management unit based in the Department of Zoology, at the College Field Station. Research interest is centred on the application of systems analysis and computer simulation techniques to ecological management, particularly to pest control problems. This position will be concerned either with (a) the use of simulation and other computer techniques for the analysis of crop disease and weed problems, or (b) the analysis of decision making in pest control and its use in the design of research projects and the implementation of their results.

The post is available from 1 January, 1978 (or other date to be arranged) and is tenable for one year, carrying a salary in the range £3355-£4190 p.a., according to age and qualifications, with USS membership. Applications accompanied by curriculum vitae, details of research experience and the names of two referees to Professor T. R. E. Southwood, at the Imperial College Field Station, Silwood Park, Ascot, Berks, by 15 July, 1977.

EAST MAILING**RESEARCH STATION A BIOCHEMIST/PHYSIOLOGIST**

To conduct research on the role of endogenous hormones in regulating metabolism particularly with reference to "source-sink" relationships and floral induction. Applications are invited from graduates with a first or Upper Second Class honours degree in biochemistry and experience with plant hormones, to work in the Plant Physiology Section.

Appointment will be in the Higher Scientific Officer grade, salary scale £3254 to £4654 per annum or in the Senior Scientific Officer grade, salary scale £4185 to £5778 according to qualifications and experience. At least two years' relevant post-qualifying experience is required for appointment as SSO, with four years for SSO. A supplement of up to £10 per week is additional. Superannuation is non-contributory.

Application forms and further details from Assistant to the Secretary, East Malling Research Station, East Malling, Maidstone, Kent, ME19 6BJ.

UNIVERSITY OF READING LECTURESHIP IN STATISTICS

Applications are invited for a Lectureship in Statistics in the Department of Applied Statistics. Candidates should be interested in the theory and applications of probability, statistics or Operational Research.

The person appointed should take up duties on 1 September, 1977 or such other date as may be arranged. The appointment will be for a fixed term of one year.

Further information may be obtained from the Registrar (Room 214, Whiteknights House), The University, Whiteknights, Reading RG6 2AH by whom applications should be received not later than 16 June 1977.

THE UNIVERSITY OF SHEFFIELD**Department of Physiology**

Applications are invited for a post of

LECTURER

in field of Neurophysiology. Medical qualification desirable but not essential. Department is responsible for teaching Physiology to Medical, Dental and Pure Science students. Tenable 1 August, 1977. Initial salary ranges: £3355-£3975 (if non-medically qualified); £3355-£4615 (if medically qualified); scale rises to £6655 a year. Particulars from Registrar and Secretary, the University, Sheffield S10 2TN to whom applications (8 copies) should be sent by 20 June, 1977. Quote Ref. B.568/H.



SCIENCE RESEARCH COUNCIL APPLETON LABORATORY CHILBOLTON OBSERVATORY

A scientist is required at the Chilbolton Observatory, near Andover, Hampshire, to assist in the development of digital equipment needed to control the 25-metre radio telescope via GEC 4080 computers and to implement the CAMAC interface system used for the experimental work. Applicants should preferably have some experience in constructing modern digital circuitry, and an interest in software would be advantageous.

The successful applicant will be encouraged to participate in the programme of experimental work at the Observatory, which currently embraces spectral and long-baseline radioastronomy and investigations of the troposphere using radar equipment.

The post will be in the **SCIENTIFIC OFFICER** grade and applicants should have a University degree, **HND, HNC** or equivalent qualifications with an electronics bias.

Salary: on the scale **£2149-£3527**, the exact step depending on qualifications and experience. In addition there are supplements to salary of **£131.20 p.a.** and **5% of total earnings** (minimum £130.50 p.a., maximum £208.80 p.a.)

Non-contributory pension scheme.

Please apply for an application form to:

The Secretary
Appleton Laboratory
Ditton Park, Slough SL3 9JX, Berks.

Closing date: 21st June 1977

Upjohn

medicine... designed for health... produced with care

Upjohn Limited has a vacancy in its International Product Research and Development Division in Crawley, Sussex for a

Biochemist/ Biological Scientist

The successful applicant will be engaged in studies involving the determination of drugs and their metabolites in biological fluids from studies in vitro and in vivo. The work involves the application of a wide range of analytical techniques and would be ideally suited to a Biochemist or other Biological Scientist with formal training in radio chemistry and other physical/chemical monitoring techniques, or to scientists with an H.N.C., M.I.Biol. etc. in an appropriate field.

Interested applicants are requested to write for an application form to

The Personnel Manager,
Upjohn Limited, Fleming Way, Crawley,
West Sussex, RH10 2NJ.

UP20

UNIVERSITY OF OXFORD**Department of Nuclear Physics**

has a vacancy in the main mechanical workshop for a

EXPERIENCED INSTRUMENT MAKER

The customary workshop skills are needed and ability in welding would be an advantage. Duties of the post include manufacture and modification of scientific equipment and work takes place both inside and outside the machine shop. Salary is Grade 5 £2889-£3867 p.a. Approximately eight weeks paid leave per year. An ONC or equivalent qualification is appropriate.

The post is funded on a rolling annual basis. Letters of application with details of qualification and job experience should be sent to the Administrator, Nuclear Physics Laboratory, Keble Road, Oxford marked with the reference number A175.

UNIVERSITY OF DURHAM**SENIOR RESEARCH ASSISTANT IN ORGANIC CHEMISTRY**

Applications are invited for the post of Senior Research Assistant in Organic Chemistry in the field of organic fluorine chemistry. Applicants should already have, or be about to submit for, the degree of Ph.D. Opportunities may be provided for the person appointed to take part in the teaching programme.

The appointment will be for two years in the first instance with the possibility of extension for a further year.

With Ph.D. initial salary in the range £3335-£4190 on National Grade 1A plus superannuation.

Applications (8 copies) including a detailed curriculum vitae and naming three referees, should be sent by 20 June 1977 to the Registrar and Secretary, Science Laboratories, South Road, Durham DH1 3LE.

OVERSEAS DEVELOPMENT

KNOW-HOW: vital to developing countries

Tanzania

Agricultural/ Training Officer

To develop and run course in land use planning, including soil conservation layout in the field. Applicants should have a degree in Agriculture with experience in soil conservation, farm planning and elementary survey. Appointment 2 years.

Salary in range £6500-£7500 pa plus variable tax free overseas allowance in range £1400-£3570 pa.

The post is wholly financed by the British Government under Britain's programme of aid to the developing countries. In addition to basic salary and overseas allowances, other benefits normally include paid leave, free family passages, children's education allowances and holiday visits, free accommodation and medical attention. Applicants should be citizens of the United Kingdom.

For full details and application form please apply, quoting ref 331, stating post concerned, and giving details of age, qualifications and experience to:

Appointments Officer,
MINISTRY OF OVERSEAS DEVELOPMENT,
Room 301, Eland House,
Stag Place, London SW1E 5DH.

HELPING NATIONS HELP THEMSELVES



Technical Information

A new service for research

This is a rare opportunity for a qualified, technically-orientated information scientist to introduce advanced information services in an original research environment. The appointment is an important one within Roneo Vickers' recently restructured R & D Department, which generates a wide range of reprographic, communications and business systems.

The technology involved is highly competitive and advancing rapidly. Research engineers and scientists need fast access to the most up to date information on international developments in the field, and your role will be to provide this current awareness through literature searches, information retrieval systems, and a technical library service. Much

depends on the efficiency and sophistication of the systems you devise in what is essentially a grassroots situation; it is important that you are fully familiar with modern information technology and its applications.

A competitive salary is being offered together with large-company benefits including, where appropriate, assistance with relocation to the Essex area which offers easy access to the amenities of London as well as rural and coastal residential areas.

Please send full career details to Dr. F. D. Riley, Budgets, Information and Planning Manager, R & D Department, Roneo Vickers Limited, P.O. Box 3, South Street, Romford, Essex, RM1 2AR.



Roneo Vickers Ltd

BRUNEL UNIVERSITY SCHOOL OF BIOLOGICAL SCIENCES DEPARTMENT OF APPLIED BIOLOGY TEMPORARY LECTURER IN PHYSIOLOGY

Applications are invited for the above post, made possible by the granting by Council of unpaid leave of absence to an established lecturer for a period of one year from 1 September 1977.

Applications are invited from persons able to teach the following subjects—

- (1) Human Physiology at 2nd MB level.
- (2) Insect Physiology as part of a final year undergraduate option in Applied Entomology.

Persons able to teach in only one of the above areas may be considered for a part-time position.

Other duties include student supervision and contributions to post-graduate courses. Opportunities for research, higher degrees and teaching experience preferred.

Salary according to qualifications and experience, within the first five points (£3356-£4199) of the Lecturer scale (£3356-£4688 plus £450 London Allowance, with PSSU/USJ benefits).

Application form and further particulars from the Assistant Secretary (Establishment), Brunel University, Uxbridge, Middlesex UB8 3PH or telephone (0494) 37188 extension 49. Closing date: 21 June, 1977.

SUNDERLAND POLYTECHNIC

Faculty of Science (Ref. Sci 2)

Interfertility Research in Energy Policy

RESEARCH OFFICERS

The work will involve a survey of British Energy Policy to identify and examine the roles of important factors both inside and outside of the institutional structure and to consider the extent to which the energy policy process can be understood in terms of frameworks of policy analysis. The post would be appropriate for a physical or political scientist with an interest in Science and technology policy.

The salary for Research Officers is £2915 plus £126 x 2 to £3165 per annum.

Please quote the project reference number when applying for an application form(s) and further particulars, which are obtainable from the Personnel Officer, Sunderland Polytechnic, Chester Road, Sunderland SR1 3SD, and should be returned as soon as possible.

UNIVERSITY OF LEICESTER

Botanical Laboratories

Applications are invited for the post of

TECHNICIAN (Grade 3)

from candidates having HND or HNC or other appropriate qualifications and relevant laboratory experience. The person appointed would have special responsibility for technical assistance in teaching and research in microbiology and related aspects of botany. Salary £2455-£2788 a year. Letters of application, giving the names of two academic referees, should be addressed immediately to Professor H. E. Street, Botanical Laboratories, University of Leicester, Leicester LE1 7RH.

ELECTRONIC TECHNICIAN (GRADE 4)

required for Department of Physiology. To be responsible for inspection and maintenance of apparatus used in laboratory classes, e.g. oscilloscopes, pen recorders, stimulators, etc., and to rectify faults or arrange for them to be rectified. Experience of electronic apparatus and ability to read and understand instruction manuals essential. Salary in range £3175-£3575 including London Weighting. Application form from Personnel Officer (Technical Staff FF 10/NS) University College London, Gower St, London WC1E 6BT.

THE UNIVERSITY OF LIVERPOOL

Department of Geology
Applications are invited for the post of
DEMONSTRATOR OR SENIOR DEMONSTRATOR
in the Department of Geology.
Applicants should have an interest in some aspect of sedimentology and experience of field studies is essential. Teaching duties will be concerned mainly with undergraduate courses in sedimentology and palaeontology. The post is tenable from 1 October, 1977, for one year in the first instance, renewable yearly, though not normally more than twice.
The initial salary will be within the range £2904-£4190 per annum according to qualifications and experience.

Applications, together with the names of three referees should be received not later than 1 July, 1977, by the Registrar, The University, PO Box 147, Liverpool L69 3BX, from whom further particulars may be obtained. Quote Ref: RV/460/NS.

Guy's Hospital Medical School**GRADUATE RESEARCH ASSISTANT**

with experience in immunochemical techniques, required for research project lasting until 31st August 1978 on complement system in renal disease. Salary in range £2,926-£3,995 plus £450 London Allowance and superannuation.

Apply in writing, with full curriculum vitae, to the Secretary, Guy's Hospital Medical School, London Bridge, SE1 9RT, quoting Ref. RM.

QUEEN ELIZABETH COLLEGE

(University of London)

Isotope Unit

Applications are invited for a **LECTURESHP IN ISOTOPE TECHNIQUES**

from suitably qualified scientists with an interest in the tracer applications of radioactive isotopes. Experience of computer control of instrumentation would be an additional, though not essential qualification.

The appointment will be from 1 October 1977 or earlier. Salary on scale £3355-£6855 p.a. plus £450 p.a. London allowance.

Applications, stating age, experience and the names of three referees should be sent to the College Secretary, Queen Elizabeth College (University of London), Campden Hill Road, London W8 7AH, from whom further details and application forms may be obtained. Closing date 20 June, 1977.

UNIVERSITY OF BRISTOL Department of Physics**RESEARCH ASSISTANT**

Applications are invited from physicists and materials scientists for a post supported by the Science Research Council to investigate the weathering of adhesive joints in hot/wet environments.

The appointment is for one year only and the salary will be within the range £3333-£3761 per annum.

Applications to be submitted by 8 June, 1977, to Dr K. H. G. Ashbee, University of Bristol, H. H. Wills Physics Laboratory, Royal Fort, Tyndall Avenue, Bristol BS8 1TL.

YOUNG CHEMIST

for non-routine analysis in an expanding company

SE LONDON

This is an opportunity for a person, probably aged 22 plus, and qualified to at least HNC/degree level in food science or chemistry to join a medium-sized expanding company in a key sector of the food industry. We take maize and convert it into glucose syrups and other products for not only the food, but also the pharmaceutical, brewing, beverage and feed compounding industries. Major extensions to our plant and buildings are now taking place.

As a chemist in our laboratories you will be involved in a wide variety of non-routine analysis associated with the starch, glucose and food industries. You will be working in a small team and there are excellent opportunities of growing with the company.

You must have experience of laboratory analysis work particularly instrumental techniques. Industrial experience an advantage.

Starting salary will depend on age and experience. There is an annual bonus and the conditions of employment include four weeks' holiday and very good pension and sickness schemes. Hours 8.00 a.m.-4.00 p.m.

Please write or telephone for an application form to Alex Nelson, Tunnel Refineries Limited, Thames Bank House, Tunnel Avenue, Greenwich, London SE10 0PA. Tel: 01-858 3271.



Tunnel Refineries Limited

Prostaglandin Biochemistry

A Post Doctoral Fellowship is available for up to two years commencing in Autumn 1977 for exploratory research in prostaglandin biosynthesis in normal and diseased tissue.

Preference will be given to candidates with experience of research in prostaglandin biochemistry and in their measurement but applications will be considered from other well qualified researchers.

The successful candidate, male or female, will have the unusual opportunity of working in a large and well equipped industrial group and be able to relate his/her fundamental research to drug invention.

Our modern research laboratories are situated in pleasant surroundings but within easy reach of main road and rail routes.

Please write quoting reference MFL2 and giving details of qualifications and experience to:—

Mr M F Losse, Personnel Officer
Imperial Chemical Industries Ltd

Pharmaceuticals
Division
Mercedes Research
Laboratories
Alderley Park,
Nr Macclesfield
Cheshire



Metabolic Chemistry Technician

Shell Research Limited are looking for a Laboratory Technician to join the Metabolic Chemistry section of our Toxicology Laboratory (Tunstall). This section researches into the fate of industrial and agricultural chemicals in biological systems and interacts with other sections on site. You will be involved in the isolation of unknown (radio-labelled) mammalian metabolites for structural elucidation, also working with isolated enzyme systems. You will employ a variety of chemical and radiochemical techniques along with preparative and analytical chromatography. If you have at least HNC Chemistry and some experience in chromatographic separations and synthetic chemistry, we would like to hear from you. Preference would be given to those who have experience in working with radio-labelled compounds and biological samples. Your salary will be based on qualifications and experience and you will be able to join our pension fund. You will be based at our Research Centre situated in pleasant rural surroundings near Sittingbourne. You could enjoy our facilities for sport and social activities, a good staff restaurant and be able to have flexible working hours. Please write or telephone for an application form to: Mrs. M. J. Hunt, Personnel Division (N2), Shell Research Limited, Sittingbourne Research Centre, Sittingbourne, Kent, ME9 8AG. Tel: Sittingbourne 24444, Ext. 203.



THE UNIVERSITY OF LIVERPOOL

Department of Dental Sciences
MRC SENIOR RESEARCH ASSISTANT

Applications are invited from biologists with a chemical background for the above MRC financed post to commence in October 1977. The post will involve studies on the metabolism of anionic polysaccharides and glycoconjugates present in the oral cavity with particular reference to the structure and properties of dental plaque and will be under the direction of Dr G. Embury. Preference will be given to candidates with post-graduate qualifications.

The initial salary will be within the range £2904-£3761 per annum depending on qualifications and experience.

Applications, together with the names of two referees should be received not later than 24 June 1977, by the Registrar, The University, PO Box 147, Liverpool L69 3BX, from whom further particulars may be obtained. Quote Ref: RV/459/NS.

NATIONAL VEGETABLE RESEARCH STATION

Plant Pathology Section

There is a vacancy for a SCIENTIFIC OFFICER

to work on a programme of research on certain virus diseases of brassicas and French (navy) beans. Qualifications required are an Honours Degree or equivalent in a relevant biological science.

Appointment in grade of Scientific Officer (£21483527) plus Phase 1 pay supplement of £335 per annum and Phase II supplement of 5 per cent of total earnings subject to a maximum of £1740 per month. Starting salary according to qualifications and experience.

Non-contributory superannuation scheme. Further particulars and application form from Secretary National Vegetable Research Station, Wellesbourne, Warwick quoting Ref. VAC/1/77. Closing date for applications 23 June, 1977.

GRADUATE ENGINEER/MATHEMATICIAN

Newcastle-upon-Tyne up to £5007

The Engineering Research Station at Killingworth requires an Engineer Mathematician to analyse pipeline and pipework stresses and evaluate the performance of existing methods of protecting pipelines against external interference.

Candidates should be under 28, and have experience in stress analysis using either finite element or classical procedures.

Salary will be within the range £3777 to £4695 plus £312 flat rate supplement.

Please write with full details of age, qualifications, experience and current salary, quoting reference RD 803915 ERS NS, to the Senior Personnel Officer (R&D), British Gas, 59 Bryanston Street, London W1A 2AZ. Closing date for applications 23rd June.

BRITISH GAS



Loss Control — Scientist

A leading risk management and loss control consultancy wishes to appoint a suitably qualified scientist as a member of its team. The consultancy is based in London and operates throughout the world using a multi-disciplinary approach and working closely with clients.

The successful applicant will undertake project work with emphasis in the field of fire and explosion hazards, their identification, quantification and control.

Candidates will be graduate chemists or chemical engineers with practical industrial experience. It is also important that the successful candidate is able to communicate effectively with all levels of management and to prepare and present papers on scientific loss control, hazard measurement and evaluation, and related subjects.

The starting salary will be in the range of £6000-£8000 according to qualifications and experience. A company car will be provided as well as a full range of fringe benefits.

Applications showing how each requirement is met should be made in writing to Box No D198.

Assistant Chemist

Salary Grade 4 (£3309-£3567)
+£312 p.a. Supplement

This post, based at Rodbourne Water Pollution Control Plant, Swindon, offers an excellent opportunity for a young graduate to gain experience in the scientific aspects of sewage and sludge treatment technology. Duties will involve some routine analysis of sewage, sludges and effluents but will be mostly concerned with investigational work on process technology and the statistical evaluation of data for presentation to management.

Candidates should hold an honours degree in Chemistry or Chemical Engineering. A working knowledge of statistics and computer programming would be an advantage.

Applications giving full curriculum vitae together with the names and addresses of two referees should be sent to the Personnel Assistant, Thames Water, Cotswold Division, 17 Bath Road, Swindon, Wilts to be received no later than Monday, 13 June, 1977.

Thames Water Cotswold Division

OXFORD ORTHOPAEDIC ENGINEERING CENTRE UNIVERSITY OF OXFORD RESEARCH OFFICER

Applications are invited for the post of Research Officer to lead the Locomotion Studies programme of the Centre. This programme forms a major part of the research effort of the Centre, and is run in parallel with other studies which cover many aspects of musculo-skeletal disease, particularly where treatment involves the use of orthoses. The programme is supported by excellent facilities, including a custom-built laboratory, force-plates, special kinematic measurement systems, and a computer.

Applicants should be graduates in physical science, and preferably would have several years' experience of biomechanics.

The appointment is at lecturer grade, and carries membership of both the Department of Engineering Science, and the Nuffield Department of Orthopaedic Surgery, of the University of Oxford.

The appointee will be expected to supervise post-graduate students and will be permitted to give undergraduate college tutorials up to a maximum of six hours per week, during term-time.

Salary: £3339-£3555, according to experience.

Applications should be submitted by 30 June, 1977.

Further details from:

J. D. Harris, Director,
Oxford Orthopaedic Engineering Centre,
Nuffield Orthopaedic Centre,
Headington, Oxford.
Tel: Oxford (0865) 64811

FIELD STUDIES COUNCIL TUTOR in Ecology

at THE DRAPERS' FIELD CENTRE, Rhdy-croau, North Wales. Single, good degree in biology or other appropriate science. Knowledge of ecological aspects and interest in locally relevant aspects of ecology an advantage. Educ. qual. desirable. Research opportunities. Salary £1947.84 + £44-£2112 plus free board and lodging. Appointment July/August 1977. Closing date for applications 17 June, 1977. Further details and application forms from The Director, Field Studies Council, Preston Mansford, Montford Bridge, Shrewsbury SY4 3JHW.

UNIVERSITY COLLEGE OF NORTH WALES, BANGOR Department of Applied Zoology

Applications are invited for the post of
TECHNICIAN GRADE 6
in the above Department.

The successful applicant should have Advanced City and Guilds, a Higher National Certificate or equivalent.

He will be required to have the experience and skill necessary to maintain and assume overall responsibility for much of the sophisticated apparatus in the Department (Audio-Visual, Photographic, GLC, Planchite and Scintillation counting equipment, etc.), also assume responsibility for the storage and security of isotopes, insecticides and various other hazardous chemicals.

Salary will be on the scale: £3314-£3580 per annum. There is a Pension Scheme.

Applications (two copies), giving age, qualification and experience, together with the names and addresses of two referees should be submitted to the Assistant Registrar (Personnel), University College of North Wales, Bangor, Gwynedd, by not later than 17 June, 1977.

STUDENTSHIPS

UNIVERSITY OF NOTTINGHAM MEDICAL SCHOOL

Department of Biochemistry

Applications are invited for
**TWO RESEARCH
STUDENTSHIPS**

available October, 1977, in the Department of Biochemistry. Project involves the characterisation of specific mRNAs from exoproduct-secreting bacteria and their translation in vitro supervised by Dr G. Coleman. Project 2 concerns biochemical and genetic studies on the control of gene expression in *E. coli*, supervised by Dr R. Glass.

Enquires and applications with the names and addresses of two referees should be addressed to either Dr G. Coleman or Dr R. Glass, Department of Biochemistry, University Hospital & Medical School, Clifton Boulevard, Nottingham.

THE UNIVERSITY OF LEEDS

DEPARTMENT OF ANIMAL PHYSIOLOGY AND NUTRITION

Applications are invited from good honours graduates or prospective students in a biological science for **RESEARCH STUDENTSHIPS** commencing in October 1977 and leading to a PhD degree in Animal Physiology and Nutrition. Research interests in the Department include: Amino acids and tissue development; specific for calcium in ruminants; control of feeding behaviour in ruminants; control of hormones, secretion of insulin; phosphorus homeostasis in ruminants. Grant and conditions are as for Research Awards. For further details write to Professor A. D. Cate, Department of Animal Physiology and Nutrition, University of Leeds, Leeds LS2 9JT. Tel: Leeds (0532) 757676.

UNIVERSITY OF EDINBURGH Science Studies Unit POSTGRADUATE STUDENTSHIPS

Applications for research in social and historical aspects of science and technology, including Appropriate Technology for the Third World. Further details from: Secretary, Science Studies Unit, 54 Buccleuch Place, Edinburgh EH8 8JT.

THE UNIVERSITY OF SHEFFIELD Department of Chemistry **CASE AWARDS IN CATALYSIS/ ORGANOMETALLIC CHEMISTRY**

Applications are invited for

CASE STUDENTSHIPS

for research on the following topics:

1. The study of the transformation of hydrogen and carbon monoxide (from coal) into industrially useful chemicals by means of homogeneously catalysed reactions. The project will be jointly supervised by Professor P. R. Halls (University of Sheffield) and Dr J. Thompson (Johnson Matthey) and work will be carried out at the University of Sheffield and also at the Johnson Matthey Research Centre (near Reading).
2. The preparation and study of new homogeneous organometallic catalysts for the asymmetric synthesis of chiral compounds. Importance: Work will be carried out at Sheffield under the direction of Dr C. White and at the I.C.I. Corporate Research Function under the supervision of Dr R. Whelan and Dr D. J. Thompson.

Applicants should possess (or expect to gain this summer) a good honours degree or equivalent qualification and will be expected to register for this degree of PhD. Maintenance grants include special allowances for approved industrial experience and for married students. Applications consisting of a curriculum vitae and the names of referees should be sent to the appropriate academic supervisor at the University of Sheffield, S1 7HF, Quote ref. A 565/H.

UNIVERSITY OF BIRMINGHAM

Neurocommunications
Research Unit

Applications are invited for a
**CASE RESEARCH
STUDENTSHIP**

commencing in October 1977, tenable for 3 years and leading to a PhD degree in Neurocommunications. The degree involves the successful completion of a nine month course in Neurocommunications as well as work with the collaborating body. Candidates should have a good honours degree or preference in the field of Biochemistry, Neurophysiology or Pharmacology.

Further details from the Secretary, Neurocommunications Research Unit, Medical School, University of Birmingham, B15 2TT.

UNIVERSITY OF WARWICK CASE STUDENTSHIPS IN MOLECULAR SCIENCES

Applications are invited from recent graduates and those expecting to graduate with a first class or upper second class honours degree in 1977 for SRC supported CASE studentships. Awards will be available for research in some or all of the following fields: Separation, Selective Modification & Synthesis; Synthesis of Polymers of Lipid Acid and Analogues; Structural Chemistry of Neptunyl Compounds; Chemical Synthesis of Diazonium Salts; Inhibition of DNA Replication; Chemical Ionisation Mass Spectrometry; Hydrocarbons.

Requests for further information and for application forms should be sent to the Chairman, Department of Molecular Sciences, University of Warwick, Coventry, CV4 7AL. Ref No: PG/18/77.

OXFORD UNIVERSITY

RESEARCH STUDENTSHIP
into problems of environmental monitoring.

The Department of Agricultural Science has research studentship, comparable to a Research Council studentship, for studies on the long term effects: sewage sludge on agricultural land. The project will involve the establishment of field trials and investigations on the chemistry of heavy metals in soil.

Applicants who should have some chemistry and/or field biology or agriculture, may obtain details from the Administrator, Department of Agricultural Science, Parks Road, Oxford OX1 3PF.



THE UNIVERSITY
OF ASTON
IN BIRMINGHAM

DEPARTMENT OF ELECTRICAL ENGINEERING

UNIVERSITY OF CAMBRIDGE
UNIVERSITY ENGINEERING DEPARTMENT
ELECTRICAL ENGINEERING DIVISION



Teaching Fellows in Electroproduction

University Senior Lecturer Scale – £6443–£7951 pa.

The Electricity Council is sponsoring two Teaching Fellows in Electroproduction – one each in the University of Aston in Birmingham and the University of Cambridge – for an initial period of five years. The aim of the two Fellowships is to promote greater understanding of all electrical methods in manufacturing industry.

Both Fellows will spend 60% of the time with the

University lecturing in the undergraduate courses in the Department, initiating new courses and developing teaching material to illustrate these courses. The remaining 40% of the time will be spent with the Electricity Supply Industry on work complementary to that in the University. The Fellows will also be expected to maintain close liaison with industry, other Universities and polytechnics.

University of Aston in Birmingham

Applications are invited from suitably qualified candidates, who should combine practical experience in the use of electroproduction, e.g. electroheat, in industry, together with understanding of undergraduate teaching.

Prospective candidates are invited to discuss the post with Professor E. J. Davies informally, before submitting applications, if they so wish. Application forms and further particulars are obtainable from the Staff Office, University of Aston in Birmingham, Gosta Green, Birmingham B4 7ET to whom applications should be forwarded not later than June 20th.

University of Cambridge

Applications are invited from candidates with a good first degree and substantial experience at a senior level in manufacturing industry.

Further information and application forms may be obtained from the Secretary of the Faculty of Engineering, University Engineering Department, Trumpington Street, Cambridge CB2 1PZ, or from Professor A. H. Beck at the same address. Applications should be submitted no later than June 20th.

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LECTURES, MEETINGS & COURSES

THE CITY UNIVERSITY

Centre for Arts and Related Studies

POST-GRADUATE COURSES IN ARCHAEOLOGICAL SCIENCE

The University offers a Diploma Course in Archaeological Science, lasting one year full-time or (subject to final approval) two years part-time. The course covers archaeological theory, dating methods, analytical techniques and metal and ceramic technology, taught through archaeological case studies. Applications are invited from science or archaeology graduates.

Research facilities in Archaeological Science are available for full-time or part-time projects leading to the degrees of MPhil and PhD.

For further details and application forms, write to Dr D. Price Williams, Centre for Arts and Related Studies, The City University, St John Street, London EC1V 4PB.

PROPERTIES OF TURBULENT FLAMES AND THEIR CALCULATION

A post experience course will be held at Imperial College on 5 and 6 July 1977. Fee £25. Details from Miss D. J. Waller, Department of Chemical Engineering and Chemical Technology, Imperial College, London SW7 2BT. Tel: 01-5955111, Ext. 1966. When replying, please mention this journal.

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Details from the **BURSAR**
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NEWPORT
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Further details from:—**Gill Bishop, RSPCA, Causeway, Horsham, Sussex. Horsham 64181**

THE CITY UNIVERSITY

Centre for Arts and Related Studies

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Ariadne

■ The new von Däniken book is out and galloping hard towards bestsellerdom, spurred by the author's lecture tour of 15 German cities, pre-publication serialisation in a mass circulation weekly and broadcasts galore. While I can't quite bring myself to read him, it seems obvious from the magnitude of his sales (now 38 million throughout the world) that von Däniken gives large numbers of people something which they feel is lacking from their lives, since science has largely destroyed religious belief. His scholarship, whether well founded or not, is not really at issue. If I can judge from the film based on his best known book about gods and astronauts, it is his capacity to extend the imagination that appeals. Be that as it may, however, he drops a rare old clanger in his latest, according to an account in *Der Spiegel* republished by *Encounter* (June). The author's big find is an article in "the reputable British journal, *New Scientist*" about the machine for making manna which the ancient Israelites possessed. Originally von Däniken was inclined to view the Ark of the Covenant as a transmitter/receiver used by Moses to communicate with divine space travellers, but the *New Scientist* article put him on the right lines. "One is tempted to speculate", he writes, "that about 3000 years ago the Earth was visited by creatures from space and that these visitors brought the machine with them." The joint authors, George Sassoon and Rodney Dale, finding themselves quoted thus reverently, are doubtless delighted that von Däniken didn't notice the issue date: 1 April, 1976. But what will the publisher do, now that he knows?

■ For a nation so much praised for successful health campaigns, the lack of even a general information poster telling the Chinese people the dangers of smoking is puzzling. The consumption of cigarettes in China is staggeringly high and getting higher. In the 10 years since 1965, the Chinese report that there was an increase of 85 per cent in cigarette smoking. Indeed the country produces nearly 2000 million lb of tobacco a year, second only to US. Yet cancer in China is responsible for about half a million deaths a year. Lung cancer occurs less frequently than colon cancer but is said to be on the increase. At least one study of smoking risks—in Peking in 1975—has been made but the doctors claimed to have found no direct links. A recent visitor to China, Michael Pertschuk of the *Washington Post*, reports that smokers may spend up to a third or a quarter of their monthly salary on cigarettes. The choice of brands, evidently, is highly tempting, you can even buy a cigarette laced with ginseng root. Is the people's opiate politically too hot to handle?

■ The extraordinary trade in bits of wild animals has, I hope, taken a severe

knock through the total ban on hunting announced by Kenya (see Comment, 26 May). A report I have shows that the wild life has taken a fearful pasting over recent years from a combination of poaching, hunting, land clearance, and drought. In 1972, for instance, the Amboseli National Park had a population of 44 black rhinos. In the park none now remains, although six survivors may have escaped to the surrounding ranchlands. Trophy hunting, of course, tends to concentrate on the best specimens, but indiscriminate poachers are the real curse. Men who killed two pregnant Amboseli rhinos in April were fined a total of only 6000 Kenya shillings, although the authorities are always aware that a man may have killed from sheer hunger rather than the pursuit of profit. The potential value of Kenya's wildlife in terms of tourism is now greater than the £25 million it is currently earning if only because in the past tourists coming to Kenya would often take in the other wildlife parks in neighbouring Tanzania, which is now setting up its own hotel network. Meanwhile I hope the ceasefire is honoured.

■ While sniffing around DREADCO for an elusive catty odour, my stereofactory friend Daedalus began to invent a "smell-camera". He recalled the photoelectric effect, in which a photon hitting a surface can eject an electron if it has enough energy to do so. He reasoned that the same principle must apply to molecules. An energetic enough photon should be able to evaporate a molecule from a surface; and from typical latent heats of evaporation Daedalus calculates

that such photons will have wavelengths between 0.3 and 0.5 micrometres in the infrared. Now, argues Daedalus, all surfaces emit infrared and have a characteristic emission spectrum. But if the surface carries volatile (and so potentially smelly) molecules, this spectrum must show a sharp drop in emissivity at the wavelength corresponding to the energy of evaporation of the molecules. For photons of this energy will not be emitted; molecules will be instead. So Daedalus's smell-camera will be built around an infrared imaging spectrometer. It scans its field of view for radiation of the chosen wavelength and presents the results on a TV screen. Set to the wavelength corresponding to the heat of evaporation of a major component of feline urine, it will clearly reveal the site of the DREADCO mog's disgrace as an ominous dark patch! All sorts of odorous accidents will be speedily located by this new device—industrial trouble-shooters and do-it-yourself electricians will grab for the smell-camera when the aroma of burning rubber, blistering paint or leaking petrol assails their nostrils. And a really sensitive model should render bloodhounds redundant for sniffing out footprints, contaminated clothing, hidden drugs and explosives and any other forensic substances it could be tuned to. A medical model identifying the molecules emitted from various areas of the subject might diagnose all sorts of diseases, as well as indicating his state of sweaty fear or anger. And a shopping version enabling ageing cabbages and doubtful fish to be identified at a dignified distance might well command a wide market.



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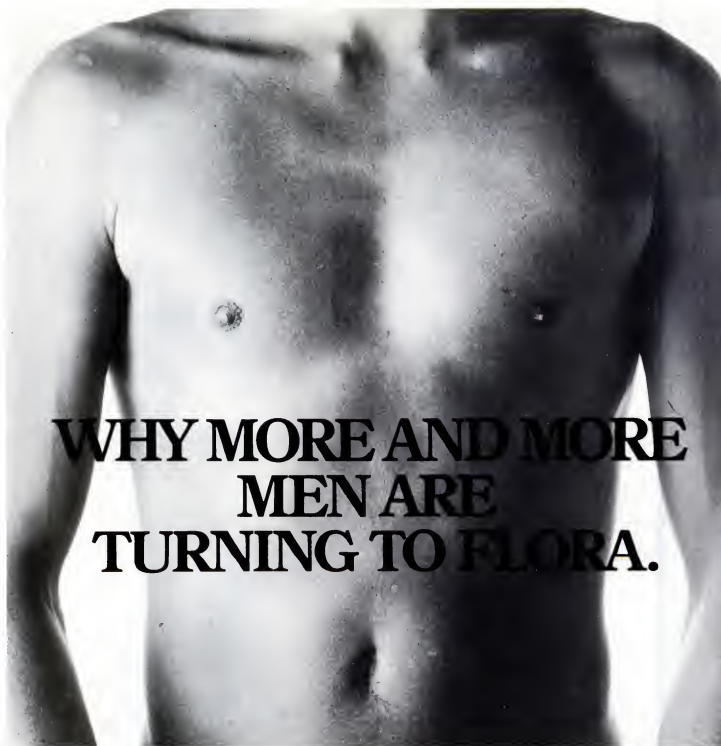
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